SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, APRIL 24, 1908

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION K—PHYSIOLOGY AND EXPERIMENTAL MEDICINE

SUMMARY OF THE PROCEEDINGS

THERE were four meetings of the section at the University of Chicago during convocation week, as follows:

First Meeting.—Manual Training School Building. Tuesday afternoon, December 31, 1907. Presiding officer: Vice-president Ludvig Hektoen. A large audience was present to hear the address of the retiring Vice-president, Simon Flexner, on "Tendencies in Pathology." (See SCIENCE, XXVII., p. 128, 1908.)

Second Meeting.—Physiology Building. Tuesday afternoon, December 31, 1907 (immediately after the adjournment of the first meeting). Joint session with the American Physiological Society. Presiding officer, Frederic S. Lee. Eight papers were read. (See the scientific proceedings.)

Third Meeting.—Reynolds Club Theater. Wednesday afternoon, January 1, 1908. Presiding officer, Vice-president Ludvig Hektoen. This session was devoted to a symposium on *Immunity* (see the scientific proceedings) and to the election of officers and other executive matters (see the executive proceedings).

Fourth Meeting.—Reynolds Club Theater. Thursday afternoon, January 2, 1908. Presiding officer, Charles E. Marshall. Joint session with the Society of

American Bacteriologists. Six papers were read. (See the scientific proceedings.)

EXECUTIVE PROCEEDINGS

The following officers were elected for the year 1908–9:

Vice-president of the Association and Chairman of the Section—William H. Howell.

Secretary—William J. Gies.

Sectional Committee—Ludvig Hektoen, vice-president, 1907–8; William H. Howell, vice-president, 1908–9; William J. Gies, secretary, 1905–9; J. McK. Cattell (one year); Frederick G. Novy (two years); Graham Lusk (three years); Jacques Loeb (four years); Charles S. Minot (five years).

Member of the Council—Edwin O. Jordan.

Member of the General Committee—H. T. Ricketts.

The following resolutions relative to research in tropical medicine were presented by the secretary, were unanimously recommended for consideration by the association and were ultimately endorsed by the association in general session:

Whereas: There exists at the present time in Panama an extraordinary opportunity for research work in certain phases of tropical medicine, through the existence there of well-equipped hospitals and well-trained medical men under the supervision of an expert sanitarian, himself a member of the Isthmian Canal Commission, and

Whereas: The solution of problems connected with this branch of medicine is of the highest importance to the welfare of this and other countries, be it

Resolved, That it is the sense of the American Association for the Advancement of Science that Congress at its present session should appropriate funds for the purpose of establishing a research laboratory on the Isthmus, to be devoted to the solution of existing problems in tropical disease.

SCIENTIFIC PROCEEDINGS

First Meeting.—Vice-presidential address: "Tendencies in Pathology," Simon Flexner. (Published in Science, this volume, p. 128.)

Second Meeting.—Papers in joint session with the American Physiological Society.

Program

"A Comparative Study of the Cilium as a Key to the Structure of Contractile Protoplasm," by C. F. Hodge and O. P. Dellinger.

"Daily Life of *Amœba proteus*," by C. F. Hodge, D. Gibbs and O. P. Dellinger.

(1) "The Reaction of *Amœba* to Stimuli of Small Area," (2) "The Effects of Prolonged Centrifugal Force on *Paramœcium*," by J. F. McClendon (by invitation).

"The Relation of Plasticity to Age in the Dancing Mouse," by R. M. Yerkes.

"The Bacterio-agglutinating Action of Lymph under Different Conditions of Lymph Formation," by B. Brande (by invitation).

"The Relative Hemolytic Action of Serum and Lymph under Different Conditions of Lymph Formation," by T. Hughes (by invitation).

"The Effect of Stimulation of the Vagi upon the Onset and Development of Rigor Mortis of the Mammalian Heart," by S. J. Meltzer and D. R. Joseph.

"The Osmotic Concentration of the Blood during Anesthesia," by A. B. Luckhardt (by invitation).

Third Meeting.—Symposium on Immunity.

Program

Introductory remarks by the chairman, Ludvig Hektoen.

"A Review of Anaphylaxis, with Especial Reference to Immunity," by M. J. Rosenau and John F. Anderson.

"Hypersusceptibility and Immunity," by Victor C. Vaughan.

"The Hemolysins of Animal Toxins," by Preston Kyes.

"The Differentiation of Homologous Proteins by Serum Reactions," by S. P. Beebe.

"On Spirochetal Immunity," by Frederick G. Novy and R. E. Knapp.

"Immunity in Rocky Mountain Spotted Fever," H. T. Ricketts and L. Gomez.

"Artificial Immunity to Glucosides," by William W. Ford.

"Virulence of Pneumococci in Relation to Phagocytosis," by E. C. Rosenow.

"The Mechanism of Streptococcus Immunity," by Gustav F. Ruediger.

"Immunity in Tuberculosis," by Mazÿck P. Ravenel.

"Chemical Aspects of Immunity," by H. Gideon Wells.

General discussion, in which many of the members participated.

ABSTRACTS OF IMMUNITY PAPERS

A Review of Anaphylaxis, with Especial Reference to Immunity: By M. J. ROSENAU and JOHN F. ANDERSON.

Anaphylaxis (ἄνα against, and φυλός guard or φυλάξις protection), also called the Theobald Smith phenomenon, hypersusceptibility, supersensitiveness, is a condition of unusual or exaggerated susceptibility of the organism to foreign substances. Anaphylaxis may be congenital or acquired; it is specific in nature. The condition of anaphylaxis may be brought about by the introduction of any strange protein into the body. Hypersusceptibility to proteins that are non-poisonous in themselves may readily be induced in certain animals.

An animal may be in a condition of hypersusceptibility and immunity at the same time. The two conditions are closely interwoven. The one may be dependent upon the other. Pirquet advises that the term *immunity* be limited to indicate the condition of complete resistance in which no clinical reaction occurs, when poisons (such as diphtheria, tetanus, etc.) are introduced into the organism. He suggests the term "Allergie" to indicate conditions of acquired immunity associated with anaphylaxis, such as that induced by vaccinia against variola, that of the luetic against syphilis, or of that produced by one attack of some of the acute specific infections. This condition of allergie manifests itself in the renewal of the infection in an entirely different manner from the reaction to the primary infection.

The tuberculin and mallein reactions are well-known instances of anaphylaxis. These substances are not poisonous when introduced into a healthy individual, but the tuberculous individual is anaphylactic to tuberculin and an individual suffering with glanders is in a state of hypersusceptibility to mallein.

The best studied instance of anaphylaxis is that produced in the guinea-pig by the injection of a foreign protein, for example, horse serum, egg white, milk, etc. Especial study has been made of the anaphylactic reaction of the blood serum of the horse, partly because that serum is so much used in serum therapy.

The first injection of horse serum into the guinea-pig sensitizes it to a subsequent injection of horse serum. A definite time must elapse—about eight or ten days—between the first and the second injections. A very minute quantity given at the first injection is sufficient to sensitize a guinea-pig.

The reaction is specific in nature. Guinea-pigs may be in a condition of anaphylaxis to three protein substances at the same time. The guinea-pig differentiates each anaphylactic-producing protein in a distinct and separate manner. This adds weight to our belief that profound chemical changes, perhaps in the central nervous system, constitute the essential features of the phenomenon rather than morphological alternations.

Hypersusceptibility to horse serum is transmitted from the mother guinea-pig to her young.

There are certain analogies between the action of tuberculosis (tuberculin) and serum anaphylaxis.

Guinea-pigs may be actively immunized against anaphylaxis. The immunity, however, can not be transferred passively to other animals in the blood serum or body juices.

Hypersusceptibility has an important bearing upon the problems of immunity. Anaphylactic symptoms may be produced in guinea-pigs by the protein extracts obtained from bacterial cells. In the case of

typhoid and colon bacilli this is followed by a definite immunity. In the case of anthrax, however, immunity does not follow hypersusceptibility to the anthrax protein. We are therefore not dealing with a general law applicable to all infections, but with certain limitations as in the case of antitoxic immunity.

Hypersusceptibility and Immunity: Victor C. Vaughan.

In order that I may be correctly understood I wish to state at the beginning that in my opinion the mechanism of immunity to all infections and intoxications is not the same and the time has come when it is well for us to distinguish between the different forms of immunity. I believe that there is already sufficient ground to justify us in holding that there are at least three forms of immunity and these I would designate as follows:

1. *Antitoxin Immunity.*—The poison to which this form of immunity may be secured are the venom of serpents, the vegetable poisons, abrin and ricin, and the toxins of bacillus diphtheriæ, b. tetanus and b. botulinus. Possibly others may be added to the list. These poisons certainly belong to a distinct group. They resemble ferments in three striking particulars: (*a*) in aqueous solution they are destroyed by a temperature of 100° or less; (*b*) they are active in solutions so dilute that they do not respond to the three most characteristic proteid color reactions, the biuret, Millon and Molisch tests; (*c*) animals treated with successive doses at short intervals develop anti-bodies. For the present at least Ehrlich's theory must be regarded as the most satisfactory explanation of this form of immunity. There is no proof, so far, that either phagocytic action or proteid cleavage has anything to do with the production of this form of immunity.

2. *Phagocytic Immunity.*—This form of immunity has been most thoroughly studied with the cocci, and as we are to have two papers on it to-day I will refrain from expressing any opinion of my own on the subject.

3. *Lytic Immunity.*—This is generally designated as bactericidal or bacteriolytic immunity, but there is serious objection to the employment of either of these terms, for the following reasons: (*a*) bacterial proteids are not the only proteids that may be and are split up in the animal body. Most foreign proteids when introduced into the circulation directly and without previous subjection to the digestive juices undergo specific proteolysis, and this is true whether these proteids are living or dead. (*b*) The cleavage of poisons in the body is probably not confined to those of proteid composition. (*c*) The term bactericidal is inappropriate because the bacteria may be so altered chemically that they are robbed in part or wholly of their harmful properties and still are not killed. Examples of the persistence of specific bacteria in the body after recovery from the disease are well known and immunity to disease may coexist with the specific bacteria of that disease still living in the body. The bacterial proteid owes its poisonous action to its molecular structure and this may be so modified as to render the organism a comparatively harmless guest without destroying its life. (*d*) The term bacteriolysis is certainly inappropriate, first because all these poisons are not bacterial and second because the word bacteriolysis means that the bacterial cell is destroyed, and we have just seen that this does not happen in all cases. In view of the facts here briefly condensed I prefer the word "lytic" to designate this form of immunity. I am not altogether satisfied with

this term and hope that some one will suggest a better.

I desire it plainly understood that in what I am to say to-day about hypersusceptibility and immunity I am speaking exclusively of what I have designated as "lytic immunity." The following statements are based largely upon work done in my own laboratory and I will condense as much as possible; and in doing so my statements may seem dogmatic, for I can not take the time to prove each of them, but such proof may be found in the papers that have been published by my students and myself.

All true proteids contain a poisonous and a non-poisonous group and can be split into these groups by the action of dilute alkali in absolute alcohol at 78°. The presence of the amino-acid tyrosin is apparently essential to the poisonous group, and those albuminoids, such as gelatine, that do not contain tyrosin yield no poisonous group. So far we have tested more than twenty different proteids, bacterial, vegetable and animal, and all that contain the tyrosin group yield a poison. Please understand that I do not claim that tyrosin is the poisonous group, but I believe it to be a constituent of the poisonous body. The poison does not contain a carbohydrate or a nuclein group, the absence of the latter being demonstrated by the complete absence of phosphorus. The non-poisonous group consists largely of nuclein, the carbohydrate being a sub-group in the nucleic-acid molecule.

The poisons obtained from these different proteids, although not identical, are similar and probably owe their poisonous action to the same or similar atomic arrangement. Much of the poison is destroyed by our crude method of obtaining it. The effect of the poison on animals is characteristic or pathognomonic and manifests itself in three stages. The first is a period of peripheral irritation manifesting itself in animals by violent scratching and in man by itching, erythema or urticaria. The second may be designated as the period of depression with or without partial paralysis. The third or convulsive stage is characterized by more or less violent clonic convulsions, generally beginning with opisthotonos and terminating in death. These symptoms are identical both in character and in sequence whether induced in a fresh animal by the injection of the free poison or in a sensitized animal treated with the unbroken proteid. When a non-lethal dose of the free poison is given, the first and second stages only appear, and the same is true when a non-lethal dose of the unbroken proteid is administered to a sensitized animal. The proteid contains the poison, which can be extracted by chemical means. The free poison and the unbroken proteid in appropriate animals induce the same symptoms, in the same sequence and in the same time. There is therefore no more doubt that the animal that dies from the free poison and the one that dies from the unbroken proteid die from the same poison than there is that the man who dies from morphine and the one who dies from opium die from the same poison. The poisonous portions of these proteids produce no antibodies when repeatedly injected into animals, and only slightly increase the tolerance for themselves. Likewise they slightly increase tolerance for the unbroken proteid in sensitized animals. Even in this, however, their action is not specific. It seems evident from these findings that the poisonous or the toxophore group in the proteid molecule plays no part in the production of lytic immunity. In this respect the production of lytic and antitoxic immunity agree, but in the former there is no antitoxin formed.

When a foreign proteid is injected into an animal and a certain interval of time is allowed to elapse, a second injection of the same proteid is likely to cause the development of untoward symptoms and possibly death in a short time. These symptoms are exactly those which I have described as being due to the free poison, and I can see no reason for doubting that they are due to the same poison which is set free in the animal body by a cleavage process giving analogous but much more perfect results than those obtained by the action of alkali and alcohol in the retort. With some proteids, the first or sensitizing dose need not be the unbroken proteid, but its non-poisonous or haptophore group. For instance, the haptophore group of the egg-white molecule sensitizes to unbroken egg-white quite as well as the unbroken molecule itself does. If the proteid of the colon or typhoid bacilli be split into haptophore and toxophore groups and animals be sensitized with the former, such animals will bear several times the ordinarily fatal dose of the homologous living bacillus. An animal sensitized with the haptophore group of a dead proteid dies on the subsequent injection of the same proteid in unbroken form, provided that the time interval between these injections has been a certain minimum or greater, this minimum varying with different proteids. An animal sensitized with the haptophore group of the colon or typhoid bacillus survives a subsequent inoculation with the living homologous bacillus. These results have struck observers as being antipodal and so they may seem, when in one instance death results in an animal apparently perfectly normal and, in the other, an animal treated with a fatal dose of toxicogenic bacterium remains unaffected. The animal that has been previously treated with the egg-white haptophore is said to be in a state of hypersusceptibility or in an anaphylactic state (without protection), while the one that has received the bacterial haptophore is said to be immune. Yet, a close study of these two sets of phenomena will, I think, convince any one that the apparently antipodal are in reality identical. In both the process is certainly identical and consists in the cleavage of the molecule of the foreign proteid and the liberation of the toxophore group. How has the one animal been sensitized or brought into this state of hypersusceptibility and how has the other been immunized? Both of these conditions have been brought about in the same manner; indeed the processes are identical. In both there has been developed in certain cells in the animal body a specific zymogen, which on the second treatment is converted into a proteolytic ferment, and this splits up the proteid into its poisonous and non-poisonous groups. The animal treated with the second injection of egg white is not killed unless the proteid given is sufficient in quantity to yield a fatal dose of the toxophore when it is split up, and the animal immunized to the typhoid bacillus is certainly killed if the inoculated bacilli be sufficiently numerous to yield a fatal quantity of the toxophore when their proteid substance is split up. Ordinarily more than a fatal dose of the dead proteid is administered at the second treatment and the animal promptly dies. What we call the minimum fatal dose of a bacterial culture does not contain enough toxophore to kill the animal, even without any acquired immunity, but it develops that amount during what we call the period of incubation, which in guinea-pigs inoculated with colon or typhoid bacilli means generally from ten to twelve hours. Now, it must be evident that if the proteid substance of the injected bacilli be split up before the living organisms have time to develop a fatal amount of the toxophore, the animal does not succumb to the inoculation and

is said to be immune. By carefully regulating the size of the second dose one can develop in both the egg-white and the typhoid animals the first and second stage of the symptoms of proteid poisoning without reaching the convulsive stage.

The effect of the poison depends not only upon the amount set free, but also upon the rapidity with which it is liberated. The poison kills by its action on the respiratory center. This is demonstrated (1) by the continued beating of the heart for some minutes after respiration has ceased, (2) by the symptoms which are those of asphyxiation, and (3) by the post-mortem findings, such as a fluid state of the blood and the engorgement of certain internal organs with ecchymoses, as found by Gay and Southardt. I infer that the poison does not destroy the cells of the respiratory center, but puts them out of commission or interrupts their normal function. The basis for this inference is the ready and apparently complete recovery of animals after manifesting the first and second stages of poisoning. Recovery after the development of the convulsive stage occurs but rarely. My reason for concluding that lytic immunity consists in the development of a proteolytic ferment is founded upon what seems to me a demonstrated fact that the symptoms are due to a cleavage of the proteid molecule into a haptophore and a toxophore group, and we know of no agents in the animal body save enzymes that are capable of splitting up proteids. I am inclined to the opinion, subject, of course, to change with additional knowledge, that the cells that become sensitized and in which the zymogen is stored are connective tissue cells and that in order to be sensitized they must come into direct contact with the haptophore group of the proteid, and the presence of the same group is necessary to convert the zymogen into an active enzyme. I think it most probable that the sensitization of a cell consists in causing a rearrangement in the molecular structure of some one of its proteid constituents. Sensitization may be local or general; it can exist only in those tissues that have come under the direct influence of the haptophore. This explains why the soluble haptophore split off from the bacterial cell is more efficient both in sensitizing and in activating the body cell than is the unbroken bacterial cell. Typhoid bacteria introduced into the abdominal cavity of an unsensitized animal may be acted upon by phagocytes, but no lytic action takes place until the body cells have been sensitized by the bacterial proteid; and their sensitization is at first local. When a coagulated proteid is injected into the peritoneal cavity of a sensitized animal the lytic action is local and the phenomenon of hypersusceptibility is never manifested, except when the activating dose is introduced into the animal in soluble form; then a large number of cells are activated at once, the proteid is split up with explosive rapidity and the poison, being set free in the circulating blood, reaches the respiratory center promptly and death as a rule follows speedily. The striking experiments of Pirquet with vaccination are, according to my interpretation of them, beautiful examples of local sensitization and consequently of local reaction. The same is, I think, true of the Calmette eye reaction with tuberculin. In some tubercular individuals the tissue of the conjunctiva has become sensitized by the split products resulting from the breaking up of the tubercle bacilli and the first application causes a reaction. But the same thing is shown more strikingly when the eye of a non-tubercular individual is sensitized by a first application and then activated by a second when the reaction is prompt, sometimes quite violent, and confined sharply to the parts touched by the first application.

I believe that lytic immunization will prove in the near future of great service not only in affording protection, but in the treatment of some infectious diseases, yet it will be well to understand at the outset that it will have its limitations and also its dangers. We can not hope for the high degree of protection that is secured by the antitoxic treatment of diphtheria. From my experiments upon animals with the haptophores of the colon and typhoid bacilli I believe that an immunity to from ten to twelve times the minimum fatal quantity of the living bacillus is as much as we can reasonably hope.

The Differentiation of Homologous Proteins by Serum Reactions: S. P. Beebe.

It is now admitted by all laboratory workers in the field of immunity that one can differentiate between the proteids of different species of animals by means of serum reactions. Such reactions are not absolutely specific, as it is well known that closely related species of animals show a mild reaction, but in point of time and completeness of the reaction it is possible to differentiate sharply between species.

With homologous proteids there is no such unanimity of opinion, although comparatively little work has been done. The serum reactions are capable of showing differences in structure which we can not demonstrate by other means, and it seems reasonable to believe that we may be able to differentiate between proteids from the same species, but from organs having widely varying functions, such as the liver and the kidney. For the purpose of developing the anti-serum the nucleoproteids of these organs have been injected into alien species of animals. The nucleoproteids were chosen because they are readily prepared and because they probably represent the most important of the cell constituents. By means of such serum one may obtain precipitin and agglutinin reactions, which are specific in the same sense that heterologous reactions are specific.

On Spirochetal Immunity: F. G. Novy and R. E. Knapp.

The question of the plurality of species of spirilla in relapsing fever, raised by us two years ago, has been answered since in the affirmative, for we now have four, and possibly five, essentially distinct strains in human relapsing fever. These several species, strains or varieties are:

S. Obermeieri—origin, Moscow, Uhlenhuth and Haendel.

S. Novyi—origin, New York, Norris.

S. Kochi n. sp.—origin, East Africa, Berlin, Koch.

S. Duttoni—origin, West Africa, Runcorn, Dutton and Todd.

S. Carteri—origin, Bombay.

The specific differences for the first four have been fully established and it is quite certain that when direct comparative tests are made with the Bombay spirillum this will also be found to be distinct. In view of these facts it may well be asked whether a still greater number of strains will not be found when further comparisons are made with the spirilla from different parts of Russia, Africa, Asia and America. From our studies on the immunity reactions of the first four spirilla we are inclined to believe that such will be the case and that a considerable number of apparently different species or strains will be discovered. The necessity for recognizing this condition of affairs will be apparent, for, as will be shown, the curative action of the serum of an animal immunized to one strain is manifested only in animals infected with that particular organism and is without appreciable effect upon the other strains.

The four strains in the order as listed above show a marked gradation of properties. This is seen in the duration and severity of the initial attack, in the frequency and intensity of relapses and in the

mortality following upon the injection of a uniform dose of 0.25 c.c. of spirillar blood, the infection with *S. Obermeieri* is mildest with barest indication of relapses and that with *S. Duttoni* is most severe; death usually results, or relapses occur regularly and are repeated, time and again. In general, the four spirilla can be readily separated into two groups, the Moscow and New York strains falling together, while the two African strains are more closely allied than with either of the others. In the African strains a notable feature is the peculiar massing of red-blood cells, which feature enables one by mere microscopic examination of the fresh blood to decide which of the two groups is concerned. There are also differences in size, the African group showing spirilla which are fully twice as long as those of the first group. A full discussion of the differences will be taken up elsewhere.

The study of the immunity or serum reactions of these four strains of spirilla presents interesting facts regarding their relationship and incidentally brings up the question of the value of the so-called specific reactions as a reliable means for the differentiating of species. The question as to what constitutes a species, itself a difficult one in connection with the higher forms of life, becomes far more difficult to answer when it concerns the unicellular organism which seemingly is incapable of presenting any fixed characteristic. Variation in the ordinary morphological and biological properties is the rule among protists and the serum reactions which are looked upon as the most specific characteristics seem to offer no exception. The differences in these reactions must be considered as an expression of changes in the molecular composition of the living protoplasm, and for each set of new conditions a new equilibrium in the arrangement of atoms must be established. The known examples of tautomerism among the relatively simple organic compounds may serve to illustrate the conception as applied to living matter.

In a previous paper we clearly demonstrated the preventive and curative action of the serum of animals immunized to the New York spirillum, and it was, therefore, desirable to ascertain whether similar results could be obtained, under like conditions, with the other three strains. Without going into unnecessary detail at the present time, it may be said that the serum of an immunized rat exerts a prompt curative action in rats infected with the corresponding or homologous spirochete, and that in like dosage it is without effect upon the remaining three organisms. This fact can best be seen from the following table:

TABLE I

Curative Experiments with Immune Sera

Rats infected with	Effect of 2 c.c. of serum of rat hyperimmunized with			
	S. Obermeieri.	*S. Novyi.*	*S. Kochi.*	*S. Duttoni.*
S. Obermeieri	+ cure	+ cure	——	——
S. Novyi.	——	——	——	——
S. Kochi.	——	——	+ cure	——
S. Duttoni.	——	——	——	+ cure

It will be seen from the above that of four rats infected with *S. Obermeieri,* and containing at the time large numbers of spirilla in the blood, the one which received the serum from a rat hyperimmunized to that organism was promptly cured, whereas the sera of the other hyperimmune animals were without any apparent effect. A like specific curative action is obtained with the other organisms when the homologous serum is used. By a "cure" is meant the total disappearance of the spirilla from the peripheral blood in from one half to four or six hours. This curative effect may be permanent or it may be followed by a slight relapse in the course of seven or ten days.

Such relapses are practically absent with the Moscow strain, very slight with that of the New York and more common with the African strains.

In the case of *S. Duttoni* the "cure" is not always as marked as with the other three, depending as it does, first, upon the dose and efficiency of the serum employed, and, second, upon the stage of infection. The latter is a most important factor. Rats in the early stage of infection with this organism (that is, on the first day following the injection of spirilla) are readily cured within half an hour without any untoward effect. The administration of the serum on the second day of the disease, at a time when the blood is swarming with spirilla, leads to agglutination and solution of such masses of organisms that death from intoxication and obstruction is the usual result. When the animal survives, the spirilla may continue to persist in somewhat lessened numbers. This latter fact is due to the presence of "immunized" or "serum-fast" spirilla. Hence, in the treatment of this disease it is not advisable to employ a curative serum, in large doses, at the time of maximum infection.

The *S. Duttoni* is especially prone to reciprocal immunization, since this organism can be found at times in large numbers, in the blood of hyperimmunized animals. This serum-fast property, first demonstrated for *S. Kochi* by Levaditi and Roché, is especially marked with *S. Duttoni,* and the recognition of this state offers a most rational explanation of the cause of ordinary relapse as well as that following the curative treatment. Hitherto it was believed that the relapse was due to the survival, in extravascular spaces, of spirochetes which after the partial destruction or elimination of the specific antibodies were able again to invade the circulation. In the light of the facts now known it is clear that the relapse is due to the survival of a few individuals which have acquired more or less immunity to the specific germicidal bodies elaborated in the infected animal. As a result a new "serum-fast" strain develops, which in turn calls for a new anti-body. The latter is apparently not as active as the first, or is more unstable, or is more readily eliminated, and hence the continuance of the relapses with this organism. This adaptation of spirilla would appear to be least marked with the Moscow spirillum, since with it relapses in rats are scarcely recognizable. On the other hand, *S. Duttoni* is at the other extreme, and from what is known of the mortality in the Bombay fever, it may be inferred that the *S. Carteri* will be found to be even more prone to relapse in rats.

As pointed out by Levaditi, the serum-fast character is perhaps a fixed property of *S. pallidum,* and without doubt this conception accounts for the persistence of that organism within man better than any other theory. The difficulty of producing a curative serum for the syphilitic spirochete will be readily seen. The phenomenon of reciprocal immunization is not limited to this group, for, indeed, it was first recognized in the study of trypanosomes. Neither can it be adduced as a characteristic of protozoa, for like conditions are now known to exist with various bacteria, and this fact must, therefore, be taken into consideration in the treatment of bacterial disease with anti-sera. Many data are now at hand which go to show the existence of a plurality of strains for nearly every pathogenic organism. And, moreover, such modifications must be expected if we assume, as there is good reason to, the existence of labile groups in the living molecule.

The practical application of the curative action of a given immune serum, it will be seen, is restricted to the infection caused by the corresponding spirochete, and hence

the need of an exact diagnosis as to kind of spirillum present. The use of a polyvalent serum, obtained from animals immunized to all four strains (and more), as can readily be done, will perhaps be desirable, especially in localities where several strains are known to occur. At present the one obstacle in the way of a realization of a perfect means for the prevention and cure of the various forms of relapsing fever is the failure to obtain artificial cultures of the spirochetes.

While the curative experiments indicate a marked specific action of each serum, this specificity disappears to a certain extent when the serum is used for preventive purposes. It will then be found that a given serum may prevent or modify the infection by two or more strains and this fact must be interpreted as indicating a close relationship of such strains. This conclusion is further borne out by cross-immunization experiments with recovered or hyperimmune animals. Certain it is that the differences between any two spirochetes, as, for example, Moscow and New York, is no greater than between *S. Duttoni* and its serum-fast strain.

TABLE II

Prevention Experiments with Immune Sera

Rats infected with 0.1 c.c. spirillar blood.	Effect of 1 c.c. of serum of rat hyperimmunized with			
	S. Obermeieri.	*S. Novyi.*	*S. Kochi.*	*S. Duttoni.*
S. Obermeieri	+	+	± slight action	± very slight action
S. Novyi.	± decided action	+	± decided action	—
S. Kochi.	—	—	+	+
S. Duttoni.	—	—	—	+

From the above table it will be seen that while a given serum has a perfect preventive action with respect to its own strain, a more or less like action is exhibited with reference to the nearest strain. The + sign shows full protection, whereas the ± indicates considerable action as revealed by delayed or mild infection. With a larger amount of serum an even more marked overlapping of immunity can be expected, and this is what actually is observed when cross-infection is attempted into recovered or hyperimmunized rats. The large amount of immune blood in these animals ensures a greater preventive action, as will be seen by comparing Tables II. and III.

TABLE III

Prevention in Hyperimmunized Rats

Rats infected with 0.25 c.c. spirillar blood.	Effect in rats hyperimmunized with			
	S. Obermeieri.	*S. Novyi.*	*S. Kochi.*	*S. Duttoni.*
S. Obermeieri	+	+	+	+
S. Novyi.	+	+	+	—
S. Kochi.	—	—	+	+
S. Duttoni.	—	—	—	+

The details of all these and other experiments must of necessity be omitted at the present time. The facts given, however, clearly show that in relapsing fever we are dealing with a group of related organisms which, while in one sense they can be regarded as distinct species, after all must be considered as derived from one stem. Further comparative studies must show whether or not this variation is even more common than is indicated by the known four strains. As to the determining factors which bring about these modifications nothing definite can as yet be stated, though the conditions involving the preservation of the virus, as pointed out by Marchoux for the chicken spirochete, may be of prime importance.

Immunity in Rocky Mountain Spotted Fever: H. T. RICKETTS and L. GOMEZ.

An attack of Rocky Mountain spotted fever, produced experimentally in the monkey or guinea-pig, is followed by strong and prolonged immunity to second inoculations. The offspring of an immune female guinea-pig are immune and their immunity

does not depend on the ingestion of immune milk.

Immune defibrinated blood in doses of 0.1 c.c. to 0.3 c.c. protects against twenty to forty times the minimum pathogenic dose of infected blood, the two being mixed before injection. One cubic centimeter of immune blood given subcutaneously protects against 20 to 40 minimum pathogenic doses of virus given subcutaneously 10 to 15 days later. This passive immunity may have a longer duration, since its limits have not yet been determined accurately.

The immune blood has little curative power when spotted fever is well established, but when given early and in sufficient quantity will shorten the course of the fever by three or four days.

Vaccination of guinea-pigs may be accomplished by a single injection or by two or more injections of immune blood mixed with virus in appropriate quantities, with the result that two months later they resist infection by twenty to forty pathogenic doses of the virus. The immunity of vaccinated guinea-pigs finds expression in the strong protective power of their blood when the latter, mixed with virus, is injected into normal guinea-pigs.

The results indicate that immune serum may be effective in preventing spotted fever in man, provided that it is given within a reasonable time following the bite of an infected tick.

It is also hoped that the vaccination method will be sufficiently satisfactory and safe to warrant its use in preventing spotted fever in man. Its value is yet to be proved on the monkey.

The nature of the anti-bodies has not been definitely established.

Artificial Immunity to Glucosides: William W. Ford.

In considering the subject of artificial immunity to glucosides, as compared with the immunity produced by the injection of poisonous proteids it should be emphasized that bacteriologists employ the term *poisonous proteids,* in a rather indefinite way, hardly ever approved of by the physiological chemists. The designation *poisonous* or *toxic proteids* or *toxalbumins* is thus applied to a group of substances embracing the true toxins characterized by certain definite physiological reactions, but never yet isolated chemically, or obtained in any condition at all resembling chemical purity. These substances are highly poisonous to animals, produce well-marked lesions peculiar to each poison injected, act upon the animal body or show their effects upon this body only after a considerable period of incubation; and by the introduction of sub-lethal doses give rise to the production of substances in susceptible animals, which neutralize their poisonous action. They are always closely associated with proteids, and are precipitated by all the well-known proteid reagents, such as alcohol, uranium acetate, aluminium sulphate, ammonium sulphate and a number of others.

They have not thus far been separated from the proteids with which they are associated, and since the purest products hitherto obtained still give the biuret reaction and still contain nitrogen and sulphur it is concluded that these substances must be proteid or proteid derivatives. A more popular designation, *proteid-like,* or *Eiweiss-ähnlich,* while possibly less objectionable from the chemical point of view, does not obviate the difficulty resulting from the use of these chemical terms, since it is rather hard to say just what constitutes the difference between a true proteid and a proteid-like body. Although one or two authorities, notably Oppenheimer,[1] believe that the toxins are not pro-

[1] Oppenheimer, "Die Bakteriengifte," in Kolle und Wassermann's "Handbuch der pathogenen Mikroorganismen," Erster Band, s, 344.

teid, it is generally accepted that successful immunization can be carried out on animals only with substances belonging in this group, variously designated as toxic proteid, proteid derivatives, proteid-like bodies, or tox-albumins, since immunization with such elements as *arsenic*, with such alkaloids as *morphin* and *strychnin* and with glucosides like *saponin* and *solanin*, and those found in digitalis and ergot has not been accomplished. Pohl[2] indeed claimed to have so treated rabbits with solanin as to render their blood serum more antagonistic to the action of solanin on blood corpuscles than the normal rabbit's serum, but his experiments could not be confirmed by Bashford,[3] in the light of whose investigations Ehrlich[4] has become positively convinced that artificial immunization with glucosides is impossible. When we consider the large number of poisonous glucosides, already isolated with a fair degree of success, and in considerable chemical purity, with but a few of which experiments have been reported, and then take account of the vast amount of work done on the toxic proteids, it is a fair inference that to deny the possibility of immunization with glucosides is to base a broad generalization upon a relative paucity of data.

Our own observations in this field originated with the attempt to immunize animals with extracts of the poisonous fungus *Amanita phalloides*, the active principle of which had been stated by Kobert[5] some years previously to be a tox-albumin powerfully hemolytic for a great variety of corpuscles. We found that saline extracts of the fungi were highly hemolytic as Kobert had stated, and that they produced very definite lesions in animals, including extensive subcutaneous edema, hemorrhages in the serous membranes, a marked degree of fatty degeneration, and a great increase of pigment in the various organs, especially in the spleen. During the treatment of animals with these extracts we experienced no difficulty in producing an active immunity, in which the animals would withstand the inoculation of two or three times a fatal dose. The serum from these immunized animals was *anti-hemolytic*[6] in a dilution of 1/1,000 or even in one of 1/5,000. When tested upon animals, one cubic centimeter of this serum would neutralize two or three multiples of a minimum fatal dose. The most powerful serum obtained was one in which 1 cubic centimeter neutralized six or seven times a fatal dose, but this serum contained such a powerful anti-hemolysin that we were led to believe that a serum from large animals more highly immunized might prove of practical value. In a chemical investigation of the fungus in the Pharmacological Laboratory, in association with Dr. Abel[6, 7] it has since been shown that the *Amanita phalloides* contains two poisons, one hemolytic and precipitated by alcohol, the other non-hemolytic and soluble in alcohol. The presence of this latter substance, the *Amanita*-toxin had already been suspected because of the poisonous character of extracts of the fungus heated to 65° C. to destroy their hemolysin, and we found that Kobert[8] had made a similar observation, publishing it in an almost inaccessible

[2] Pohl, *Arch. internat. de Pharm. et de Ther.*, 1900, 7, p. 1; 1901, 8, p. 437.

[3] Bashford, *Arch. internat. de Pharm. et de Ther.*, 1901, 8, p. 101; 9, p. 451.

[4] Ehrlich, "Collected Studies on Immunity," New York, 1906, p. 433.

[5] Kobert, *St. Petersburger med. Wochenschr.*, 1891, 16, pp. 463, 471.

[6] Ford, *The Journal of Infectious Diseases*, Vol. III., No. 2, April, 1906.

[7] Abel and Ford, *The Journal of Biological Chemistry*, Vol. II., No. 4, January, 1907.

[8] Kobert, *Sitzungsberichte der naturforschenden Gesellschaft zu Rostock*, 1899, p. 26.

journal. It was further shown by Dr. Abel and myself that this *Amanita*-hemolysin is not a tox-albumin as Kobert had stated, since all proteid can be removed from it, by the use of freshly prepared metaphosphoric acid, and by uranyl acetate, without any appreciable impairment of its hemolytic activity. Our hemolytic solution thus treated no longer responds to any of the well-recognized tests for either native or derived proteids. Although this hemolysin has by no means been obtained in a condition of chemical purity, it must, for the present at least, be classified as a glucoside because of the following reactions which our purest substance gives.

1. It reduces Fehling's solution and ammoniacal silver solution only very slightly without previous hydrolysis with acids, and very powerfully after such hydrolysis.

2. It does not ferment with brewers' yeast either before or after hydrolysis.

3. It gives characteristic tests for pentoses with (*a*) *a*-napthol and sulphuric acid, (*b*) phloroglucinol and hydrochloric acid, (*c*) orcinol, hydrochloric acid, and ferric chloride. It also decolorizes an alkaline solution of potassium permanganate at room temperature, and after hydrolysis gives a yellow color with sodium hydrate.

The alcohol-soluble *Amanita*-toxin, which probably is more important in cases of poisoning in man because of its resistance to the action of heat and acids than the *Amanita*-hemolysin has been shown by Dr. Schlesinger and myself[9] to be either an *indol* or *pyrrol* derivative or an *aromatic phenol* so combined with an amine group that it readily forms an indol or pyrrol ring on fusion. This substance can be obtained free from both the glucosides and the native proteids present in the plants.

Since publishing these various observations a number of experiments have been completed which confirm our earlier conclusions and throw light upon some of our difficulties, and it is desirable at the present time to take up these further experiments in brief detail. In the first place, Dr. Kinyoun while at the Mulford Laboratories at Glenolden, Pa., was good enough to immunize a horse for me with aqueous extracts of *Amanita phalloides* and found that its serum contained anti-bodies for the poisons of this fungus of such a strength that one fourth of a cubic centimeter would neutralize the poisonous dose for a 500-gram guinea-pig. While this is of hardly more than theoretical value, in studying this serum during the past year we have found that it contains a strong and permanent anti-hemolysin operative in a dilution of 1/1,000, using as an index that quantity of hemolysin which will dissolve 1 cubic centimeter of a 5-per-cent. suspension of blood corpuscles, and this anti-hemolysin is still present, even though the serum is nearly a year old.

Again, it has been shown that both the *Amanita*-hemolysin and the *Amanita*-toxin are poisonous to small animals, the lesions produced by the latter substance being similar to those seen in fatal cases of poisoning in man. The *Amanita*-hemolysin apparently owes its toxicity entirely to its blood-making properties, the pure toxin acting as a cellular poison, producing both the hemorrhages and the fatty degeneration.

The *Amanita*-hemolysin, moreover, tends to lose its activity on heating to 65° C. for one half hour and may play but a secondary rôle in fatal cases in man, the toxin possibly being the more important principle. Various animals have been immu-

[9] Schlesinger and Ford, *The Journal of Biological Chemistry*, Vol. III., No. 4, September, 1907.

nized to the two poisons in the *Amanita,* the hemolysin and the toxin. Immunization with the hemolysin proceeds without difficulty, the animals reacting well and retaining their weight. Their serum is always powerfully anti-hemolytic, a strength of 1/1,000 being found after four or five injections. Active immunity with the toxin can also be produced, the animals resisting the inoculation of two or three fatal doses and their serum conferring passive immunity upon other animals up to a limited point. At no time, however, have we obtained a higher degree of either active or passive immunity with this portion of the fungus than with the "whole extracts." We are thus confronted with the paradoxical condition that the glucoside in the fungus for which on theoretical grounds an anti-body would be supposed to be impossible will readily stimulate animals to the production of an anti-hemolytic serum, while the non-glucosidal substance is thus far the barrier to the production of a high degree of immunity. To just such an extent as the hemolysin acts in man can we obtain an efficient antitoxin, but since the toxin is apparently more potent in this respect than the hemolysin, no practical results can possibly be hoped for until some method of obtaining a stronger serum for this fraction of the fungus can be devised.

Finally, it has seemed to Dr. Abel and myself, in view of the direct contradiction which our results bear to those of Kobert, an important matter to repeat some of our earlier observations, and we have confirmed the conclusions as to the non-proteid character of the hemolysin in *Amanita phalloides* by obtaining proteid-free hemolysins from other specimens of this fungus from New York State and from Massachusetts, thus covering in these studies three widely separated localities. The hemolysins in the fungi from these three different sources can all be completely neutralized by the serum made by Dr. Kinyoun from the Maryland fungi, a fact which further points to the identity of this substance in various examples of the plant, and its wide distribution. Indeed, no typical specimens of *Amanita phalloides* have thus far been studied in which the *Amanita*-toxin, when present, was not accompanied by this blood-laking principle.

Having thus shown that an anti-hemolysin can be made for a hemolytic glucoside, it became imperative to determine whether this was a fortuitous circumstance, dependent upon some peculiar composition of the substance employed, or whether there were not other poisonous glucosides with which animals could be successfully immunized.

The most important poison available for these studies was the active principle of *Rhus toxicodendron,* or poison ivy, from both the theoretical and practical standpoint. It had some years previously been shown by Pfaff[10] that the poison of this plant was a non-volatile oil, decomposed by heat, soluble in alcohol, ether, benzine, chloroform, etc., but insoluble in water. The name *Toxicodendrol* was given to this oil. Subsequently Syme[11] has concluded, on the basis of extensive experimental work, that the irritating substance of poison ivy is a glucoside, a compound of *rhamnose, gallic acid* and *fisetin.* To this substance the name *Toxicodendrin* is applied.

It is possible to obtain this active principle in the fluid extract of *Rhus toxicodendron,* an alcoholic extract of the fresh leaves of the plant, from which a tincture

[10] Pfaff, *Journal of Experimental Medicine,* 1897, Vol. 2, p. 181.

[11] Syme, "Some Constituents of the Poison Ivy Plant (*Rhus toxicodendron*)," Johns Hopkins University Dissertation, Baltimore, 1906.

is made and employed in a number of affections by a certain group of medical men. Pfaff had previously pointed out that the internal administration of toxicodendrol to rabbits killed them at the end of 12–15 days by nephritis, although some animals died in convulsions within the first 24 hours. The subcutaneous inoculation of the fluid extract of *Rhus toxicodendron* produced in rabbits an intense nephritis with large quantities of albumin and many casts in the urine, the animals dying in from 8 to 15 days. Rarely some of the rabbits died in convulsions on the first day. The effects of the fluid extract being identical with those described by Pfaff for toxicodendrol, there could be no doubt that this extract contained the active principle. In addition to the nephritis, a huge necrosis and slough developed at the site of the subcutaneous inoculation. Guinea-pigs are more susceptible to the poison than rabbits, a small quantity producing a similar local necrosis and nephritis. The fatal dose for rabbits varies from one half to two cubic centimeters, and for guinea-pigs from one fourth to one half cubic centimeter. With both species, if small doses be given at first, followed by increasing doses at appropriate intervals, active immunity can be established. Large quantities of the fluid extract can eventually be given, three to four cubic centimeters in guinea-pigs and eight to ten cubic centimeters in rabbits, in both cases representing a considerable multiple of a minimum fatal dose. The time of the dosage must be carefully graduated, the most favorable interval between the periods of administration being apparently ten to twelve days, corresponding to about the period of incubation. With low multiples of a fatal dose, the animals react well, develop no local lesions, and can be kept alive almost indefinitely, no late manifestations of intoxication appearing. If too large quantities be given, the animals die of nephritis, and occasionally local lesions are found. In general, however, the local action of the poison on the epithelial cells of the skin is less likely to appear during immunization than the destruction of the kidney cells.

The serum from these actively immunized animals will confer passive immunity upon other animals. For these experiments guinea-pigs were always selected because of their more regular susceptibility. The poison and serum must be administered separately to avoid the precipitation of the serum by the alcohol in the fluid extract, and even in the severe test of giving both doses at the same time the serum will completely neutralize the poison. In certain instances by this method of testing, one cubic centimeter of serum neutralized five or six fatal doses for guinea-pigs. When the effects of the *Rhus toxicodendron* are not completely obviated, the test animals die of nephritis. Careful dissection of the skin at the site of inoculation shows no necrosis or slough.[12]

In connection with the effect of *Rhus toxicodendron* upon the kidney in the production of active and passive immunity, it may be mentioned that the only human beings who have died as a result of ivy poisoning have apparently succumbed to kidney affections.

Large animals can also be immunized; a fifty-pound goat was eventually given twenty cubic centimeters without the development of subcutaneous lesions or nephritis.

Finally, it is interesting to inquire whether *natural immunity* to poison ivy occurs in man, and whether immunity develops after recovery from its effects. In regard to the first point, there is no difficulty in showing that many persons are

[12] Ford, *The Journal of Infectious Diseases*, Vol. 4, No. 4, November, 1907.

quite resistant to the action of the irritating substance. I know personally of a number of individuals who have been able since early childhood to handle poison ivy with impunity, no dermatitis resulting from contact with the fresh leaves. Opinions differ much in regard to the acquired immunity. Some people are extremely susceptible, the severest lesions following the slightest exposure. In many instances it is claimed that no immunity results from the first attack, a second, third or even a fourth attack of dermatitis occurring with painful regularity. A belief is common, moreover, that these subsequent attacks recur, without a second exposure, at the same season in which the first attack developed. There are, nevertheless, many cases in which a certain degree of immunity develops, the severe types of dermatitis never being reproduced, the subsequent exposure bringing out only a few vesicles and pustules on the skin.

It is interesting to speculate whether these cases of *natural immunity* are not really examples of *acquired immunity*, individuals in whom as children the effects of handling the ivy have gradually worn off, the original dermatitis having been so insignificant as to have escaped notice or being so many years distant as to be forgotten.

There is some evidence also as to the possibility of vaccinating against ivy poisoning. The internal administration of the tincture of *Rhus toxicodendron* is believed by many to completely prevent attacks of this affection, and in the survey for the Union Pacific Railway, when the line was pushed through a wild country much overgrown with the ivy, some of the engineers discovered that by chewing and swallowing the fresh leaves early in the spring, they could ward off attacks during the summer. It is stated that a similar precautionary measure is resorted to in the Adirondack Mountains, where the plant is so abundant as to be a troublesome pest.

In conclusion we have in the *Amanita phalloides* and in *Rhus toxicodendron* two poisonous substances, acting in one case upon the blood corpuscles, in the other upon the epithelial cells of the skin and kidney, in both of which the evidence at hand points to a glucoside as the carrier of the poisonous properties, and in both of which active and passive immunity may be experimentally produced. Whether these observations have anything more than theoretical value remains still to be determined, a practical application of these results being possible only when sera of considerable antitoxic power can be obtained from large animals.

Virulence of Pneumococci in Relation to Phagocytosis: E. C. ROSENOW.

Virulent pneumococci do not absorb opsonin from serum nor are they susceptible to phagocytosis, while non-virulent pneumococci absorb opsonins and are freely susceptible to phagocytosis. The pneumococci isolated from the blood in pneumonia resist phagocytosis in normal and pneumonic blood, while those isolated from the sputum are more susceptible and show a correspondingly lower grade of animal virulence. It seems that the pneumococci in the blood in lobar pneumonia are there because of their resistance to opsonification and phagocytosis.

The pneumococci isolated from the blood of cases of pneumococcus endocarditis are freely susceptible in vitro, to phagocytosis, both in normal and homologous blood, and yet in some way they are able to protect themselves against the action of the leucocyte and other cells in vivo because constantly present in the circulating blood. The recently isolated pneumococci in these cases when grown in the homologous serum from 24 to 48 hours instead of being

freely susceptible to phagocytosis, as is the case when grown in broth or upon agar, have become fairly resistant instead. When grown in normal serum they fail to acquire this resistance to the action of opsonin and the leucocyte.

Extracts from highly virulent pneumococci contain a substance or combination of substances which neutralize the opsonin in serum. This substance unites with virulent pneumococci quantitatively and by so doing confers upon them a degree of resistance to phagocytosis as well as to animal virulence. The extracted virulent pneumococci now acquire the power to absorb pneumococco-opsonin. In other words, it seems possible to extract from virulent pneumococci the substance upon which virulence probably depends and to which the name "virulin" has been given. While the action of virulin may be the subject of several hypothetical explanations, at present it is probably best to look upon it simply as a substance or mixture of substances which when united with the pneumococcal cell prevent the cell from taking up opsonin, and which substance, when free, has special affinity for opsonin. That it does not merely concern free opsinophile cell receptors seems likely because virulent pneumococci when extracted, that is, freed from virulence, are found to absorb pneumococco-opsonin freely.

The Mechanism of Streptococcus Immunity: Gustav F. Ruediger.

In a previous paper it was shown that, in test-tube experiments, suspensions of rabbit leucocytes in normal rabbit serum or blood destroy avirulent streptococci but not the virulent organisms. Suspensions of the leucocytes in heated serum or in 0.85-per-cent. NaCl solution do not destroy the avirulent streptococci. Dr. Hektoen and I have shown that the avirulent streptococci are freely taken up by rabbit leucocytes in normal serum, but the virulent organisms are not taken up. Washed rabbit leucocytes in heated serum or in 0.85-per-cent. NaCl solution do not ingest the avirulent streptococci.

Rabbits were now immunized according to Neufeld's method by injecting them first with a large dose of heated virulent streptococci and then with several doses of the living culture. These animals acquired an immunity so that they did not succumb to a subcutaneous injection of twice the minimum fatal dose of the streptococcus. In test-tube experiments it was now found that normal rabbit leucocytes, or washed leucocytes from an immune rabbit, when suspended in the immune rabbit serum, freely ingest the virulent streptococci. If, however, these leucocytes are suspended in normal rabbit serum they scarcely take up any of these streptococci. No difference could be detected between the normal leucocytes and those coming from an immune rabbit. The immunity is dependent upon a change in the serum, as the following experiment shows. Virulent streptococci were sensitized in the immune rabbit serum and another lot was treated similarly with normal serum. These cocci were suspended separately in salt solution and each suspension was added to a suspension of washed rabbit leucocytes in salt solution. It was found that the streptococci which had been sensitized in the immune serum were taken up by the leucocytes to the extent of eight per leucocyte, whereas those which had been sensitized in the normal serum were not taken up at all. That is, the serum had acquired something by virtue of which it was enabled to sensitize the virulent streptococci so that they were ingested by the rabbit leucocytes.

The immune rabbit serum does not possess anti-streptolytic properties.

Fourth Meeting.—Papers in joint session

with the Society of American Bacteriologists.

Program

"Passive Diphtheritic Immunity in Rabbits," by H. M. Goodman.

"The Changing Flora of Chronic Suppurations: Its Relation to Opsonotherapy," by A. P. Ohlmacher.

"Blackhead: A Coccidial Disease of Turkeys," by P. B. Hadley (by invitation).

"The Cause of the So-called Germicidal Property of Milk," by M. J. Rosenau and G. W. McCoy.

"The Significance of Leucocytes and Streptococci in the Production of a High-grade Milk," by Mary E. Pennington.

"A Note on the Occurrence of Leucocytes and Streptococci in Milk," by S. C. Prescott.

WILLIAM J. GIES,
Secretary

PUBLICATION IN GERMAN JOURNALS OF THE RESULTS OF AMERICAN CHEMICAL RESEARCH

IN the course of an address on "American Chemical Research," delivered before the American Chemical Society last June,[1] a brief reference was made to the practise of some American chemists of publishing the results of their investigations more or less systematically in German journals. Since the address was printed I have had opportunities of discussing the topic with various friends, several of whom publish in the manner indicated, and it has been suggested that it might be useful—and even interesting—to deal with the question at somewhat greater length.

It will, perhaps, be wise to state at the outset that, in my opinion, there can be no question as to the absolute *right* of an investigator to offer his results for publication when, where, how and to whom he pleases, but "all things that are lawful are not expedient," and it is really on this that the question turns. Closely interwoven with it are two other questions: Should the chemists of America combine to form a society? Should this society publish a journal?

The answers given by the chemists of the country have been unmistakably in the affirmative, consequently, it would appear to be the merest common-sense on the part of all interested, to endeavor to make both the society and its journal the best possible. It has sometimes been urged against the society that its admission requirements are too lenient and that it would be advantageous if its membership were limited to persons possessing some "qualification." Just what the nature of their "qualification" should be it is difficult to discover. Although this idea is, perhaps, attractive at the first glance, a little thought will show many serious objections to it. Only two of these need be mentioned at present. The one concerns the expenses of publication and is dealt with more fully below. The second objection may be expressed by saying that no society can be truly national in its scope and aims unless its membership includes all or nearly all of those professing the subject with which it deals. In the case of the American Chemical Society this battle has been fought and won. In numbers it ranks as the third largest association of chemists in the world and very soon it will take the second place. The fact that the names of all the better-known chemists of the country are on its roll proves that quality has not been sacrificed to quantity.

We may now consider the subject of publication. In his recent address to the American Chemical Society, during the Chicago meeting, President Bogert was understood to say that the *Journal of Physical Chemistry* and the *Journal of Biological Chemistry* have each a circulation of about 200, and that they do not pay their expenses; moreover, the editors give their services. No information could be

[1] SCIENCE, 26, 625 (1907).

obtained regarding the *American Chemical Journal,* although a request for it had been made. It is fair to assume that the wider scope of this last journal is probably correlated with a somewhat larger circulation; the editor's services are also gratuitous, and it is generally understood that, whatever may be the case at present, for many years its publication involved a financial loss. The *Journal of the American Chemical Society,* on the contrary, does pay expenses, including a small honorarium to its editor. Its solvency is due, of course, to its large subscription list. To put the matter in another way, chemists engaged in research do not pay the cost of publishing their results and, indeed, can not afford to do so. Consequently, in order that they may be truly independent not only of the munificence of individuals, but also of the control which this munificence necessarily involves, it is essential that those chemists who do research should combine with those who are otherwise engaged; the partnership is a thoroughly honorable one on both sides, the one furnishes the money, the other the results.

This mutual dependence has, however, another phase. We can not expect the "man who pays" to continue to pay unless he receives value for his money, but the value of a scientific journal, unlike that of a popular magazine, is dependent entirely on gratuitous contributions. It can not buy its talent, but must take what material is sent to it.

It would appear, therefore, that every paper by an American chemist which is printed in foreign journals is not only a distinct loss to his non-publishing chemical brethren, but it also acts injuriously on the interests of those who are actively engaged in research, because it renders the native journals less valuable and, therefore, tends to restrict their circulation. Moreover, this loss and injury are greater in direct proportion to the value and general interest of the papers in question. Few who have not looked into the matter realize how much the *Zeitschrift für physikalische Chemie* owes to its American contributors. A similar state of things prevails in the domain of organic chemistry, which is indebted to American chemists for two of the most interesting and important conceptions which have enriched it within recent years; unfortunately—as I venture to think—they have been developed in the *Berichte der deutschen chemischen Gesellschaft,* and in *Liebig's Annalen der Chemie,* respectively.

Some of the most valuable results obtained by a few American chemists appear in the publications of certain of the learned societies. Very frequently the society in question has contributed funds towards the cost of the research. In such cases it is only fair that the society should have an opportunity of making known the discoveries. The "American Academy," which is, doubtless, the most important association of this nature, publishes 850 copies of its *Proceedings,* 200 of which are supplied to the author. Of the remainder, about 450 go to various libraries and learned societies all over the world and the other 200 to the foreign honorary members and to those members and associate members who desire to receive them. Other people can obtain the articles at a relatively small cost. It is impossible to doubt that the circulation of the *Proceedings* is of a very high order, but I fear that it is equally certain that their contents fail to reach the mass of American chemists, and it is with their interests that I am immediately concerned; the specialist can generally take care of himself. For many years it has been customary for the *American Chemical Journal* to reprint articles which have ap-

peared in the publications of various societies; possibly a similar course might be followed by other journals.

Of the reasons which have been given in support of the habit of publishing in German journals, three only need be considered very seriously. An article may appear in the *"Berichte"* six weeks after the copy has been mailed from this side of the water, but if it be sent to one of the American journals the time which elapses before publication is often greater. The fact that the domestic journals are all monthlies, whereas the *"Berichte"* appears seventeen times per annum, accounts for some of the delay, which, in any case, is not very great. I am informed that the average length of time required for publication in the *Journal of the American Chemical Society* is five to nine weeks, according to the date of the receipt of the manuscript. As a rule, the delay, as compared with the *"Berichte"* is not greater than the length of time, three weeks, required for the double journey across the ocean. In the case of very brief papers, or when special reason can be shown for haste, the time mentioned above can almost always be shortened. In my own experience of this journal a paper appeared about two weeks after the copy was sent to the editor. During the Chicago meeting of the American Chemical Society statements were made to me by several people regarding the great delay attending publication in the *American Chemical Journal.* One gentleman from the middle west declared that a relatively short paper of his would have to wait six months before appearing. In some cases even a longer period is necessary, as I have found, but it was also the custom of the editor of this journal to expedite the printing of papers when the authors showed that their interests would suffer materially from delay.

The second of the three reasons referred to is embodied in the following statement: "Germany is the leader of the chemical world, and papers published there reach directly, with a minimum expenditure of time and trouble, those for whom the contents are specially designed." As regards the first part of this statement, it may be pointed out that Germany is likely to continue to lead the world so long as the results of the best work done in other countries are published within her borders. Are we all to publish everything in German? If not, where is the line to be drawn?

The third reason referred to above surprised me a good deal, but it was made by a high authority. "Few Germans can read English with facility, whereas most English-speaking chemists have no difficulty in dealing with German, and it is not right to say to the Teuton 'if you will not learn my language you shall not know of my work.'" To this it may be replied that the German chemist shows no indication of any anxiety to consider the susceptibilities of other people concerning the language question and, consequently, there is no special necessity to consider his feelings. If he can not or will not trouble to learn English let him get his information at second hand, from abstract journals, or let there be duplicate publication in each language. Provided that the paper appears *first* in English, and a clear indication is given in the German edition that this latter is a reprint, then, personally, I have no serious objection to offer to its duplication. The question is essentially one between the German editor and his subscribers. As regards the general ability of the English-speaking chemists to read German I fear that my friend has overrated them. Enquiry shows that it is very doubtful if fifteen per cent. of the mem-

bers of the American Chemical Society see the "*Berichte*" regularly, and probably less than five per cent. read any other German journal. The relatively small number of Americans who belong to the German Chemical Society speaks for itself.

Science is world-wide but "charity beginneth at home." It would appear to be only fair that the country which provides the expenses of an investigation should have the first opportunity of enjoying its results, whether these be in the realm of pure or of applied chemistry. Is it too much to ask those American chemists who are so happy as to combine unusual natural ability with the most favorable opportunities for its cultivation, if they will not make the results of their work more directly and easily available to those of us who are less highly favored? Publication in American journals, even when it involves delay, will in no way diminish the authors' fame and will undoubtedly prove to be a great help and inspiration to their younger and less well-known colleagues.

J. Bishop Tingle

McMaster University,
Toronto, Canada,
March, 1908

SCIENTIFIC JOURNALS AND ARTICLES

Some months ago it was announced that the publication of *The Journal of Morphology* would be resumed under the auspices of the Wistar Institute. The first number of Vol. XIX. has just been issued.

The reorganization of this journal suggested the possible advantages which might accrue from a centralization in one publication office of a number of anatomical and biological periodicals. There seemed to be no doubt that more material could be published with the same funds and that there might be other advantages in publishing a number of journals from one office. The economies are too evident to need enumeration. The most vital point, however, and the one which seems to offer reasonable doubt is the question of representative editorship. It is essential that our best anatomical and biological periodicals continue as national organs edited by representative anatomists and biologists. The danger of a central office of publication is that the journals, thus centralized, may perhaps become local organs of the institution producing them. This danger must be carefully guarded against.

The Wistar Institute, by means of its advisory board, is making every effort to do national work and for this reason the danger referred to seemed so remote that four other journals, namely, *The Journal of Comparative Neurology and Psychology, The American Journal of Anatomy, The Anatomical Record* and *The Journal of Experimental Zoology,* have been assigned to the Wistar Institute. The institute has accepted these journals on condition that the same editorial boards shall continue responsible for the scientific material published, and that these boards be made up of representative men. The institute accepts the responsibility as an opportunity to aid by cooperation in the increase and improvement of the various means for publishing contributions in the field of anatomy and biology, and to relieve the various editors of some of the more arduous duties connected with an editorial office.

Any financial support which the institute may be called on to give will be at the expense of its own research work, and it must be understood that other institutions are not released from their responsibilities by the fact that the Wistar Institute has assumed the burden of publishing these journals in the interests of economy and improvement.

Fortunately, the financial burden is borne, for the present, by private contributions, but it is hoped that institutions and individuals will, nevertheless, take active interest in placing all these journals upon a self-supporting basis.

Acting through its advisory board and through the various editorial boards of the above mentioned journals, the Wistar Institute will make every effort to establish high standards in the various departments of its publi-

cation work and cooperate in every possible way to secure for the biological workers of the country the form of publication and distribution which their researches deserve.

SOCIETIES AND ACADEMIES

THE WASHINGTON ACADEMY OF SCIENCES

MR. C. G. ABBOT, the director of the Astrophysical Observatory of the Smithsonian Institution, delivered before the academy, March 24, an address on "Recent Studies of the Sun."

Mr. Abbot gave a summary of the researches included in Volume II. of the *Annals of the Astrophysical Observatory of the Smithsonian Institution,* now about to be issued. Besides this he gave a brief account of the Smithsonian expedition to observe the total solar eclipse of January 3, 1908.

The mean value of the solar constant of radiation in calories per square centimeter per minute from 44 observations at Washington, D. C., 1902–6, is 2.061; from 59 observations on Mt. Wilson, California, in 1905, it was 2.024, and from 62 observations at Mt. Wilson in 1906 it was 2.020. Langley thought it necessary to add about one third to his solar constant value from Mt. Whitney observations of 1881 because of a supposed failure of Bouguer's transmission formula. This correction does not appear to be justified, and Langley's values should be as follows: For Lone Pine 2.06, for Mountain Camp 2.22, and their difference is reasonably attributed to experimental error, not difference of altitude. The fact that so good agreement between the Washington, Lone Pine, Mt. Wilson and Mt. Whitney values is found makes it most probable that the true solar constant value differs very little from 2.1 calories. It was shown from the temperature of the earth's radiating surface that the solar constant can not exceed 2.33 calories unless the reflecting power of the earth as a planet exceeds 37 per cent. The latter value was derived by measuring the reflecting power of clouds and other terrestrial surfaces.

Variations of the solar constant values were noted both in Washington and on Mt. Wilson, and these are so large and so well established by observation as to warrant the continuation of solar constant work at two observatories in cloudless regions of the earth well separated from one another. A study of the surface temperatures of the earth at 48 inland stations widely distributed over the globe indicates that general variations of temperature have occurred which may have been caused by solar variations of short period. The sun-spot cycle is clearly associated with a temperature variation; for higher temperatures occur at sun-spot minimum.

The variation of brightness of the sun's disk from center to limb has been observed for various wave-lengths of light, and on numerous days of observation. Changes of the rate of this variation have been noted from time to time, and these changes may prove to be associated with variations of the solar constant of radiation. Probably the cause of the decreased brightness near the sun's limb is the lower temperature of the sources of light near the limb, due to the fact that the scattering of light by the molecules of the gases of the sun prevents us from seeing as deep near the limb as at the center of the disk. The scattering of rays is so great in the atmosphere of the earth that, reasoning by analogy, scattering probably prevents us from seeing at the center of the sun's disk as much as 1 per cent. of the solar radius below the outer photospheric layers, and far less even than this at the sun's limb, owing to the greater length of path of the rays to a layer of given depth. This explains the apparently sharp boundary of the sun's disk, notwithstanding the necessity of admitting the gaseous nature of the sun on account of its extremely high temperature.

The Smithsonian Institution sent Messrs. Abbot and Moore to Flint Island by invitation of Director Campbell, of the Lick Observatory. They observed there, on January 3, 1908, the intensity of the rays of the solar corona at five points, and found them at brightest only 1/1,000,000 as bright as sun rays. They employed a bolometer in focus of a twenty-inch equatorial reflecting telescope. Glass was in front of the bolometer to prevent exchanges of long wave-length rays. By means of an

asphaltum varnish screen it was found that the quality of coronal and solar radiation transmitted by glass differed little in relative proportion of visible and infra-red rays. From this and other observed facts it was inferred that the coronal radiation may probably be mostly reflected sun rays. The absence of Fraunhofer lines in light of the inner corona was attributed to the bright line spectrum of hot gases in the corona superposed on the spectrum of reflection.

In the discussion that followed Mr. Abbot's address, Professor Frank H. Bigelow reviewed the difficulties of determining the solar constant and Professor C. F. Marvin remarked upon the great ingenuity and skill shown during this investigation in devising instruments and making observations in a difficult field.

Mr. J. F. Hayford expressed his ardent admiration of the research presented in Mr. Abbot's address and stated that as he had heard of the research during its progress and read the proof of the complete paper of which his address is an abridgement his view-point was intermediate between that of the expert—Mr. Abbot—and that of the audience.

According to Mr. Hayford the grand tactics of this research are especially admirable. They involve broad principles, skilfully applied, which are of general importance in any line of scientific research.

This has been a long investigation, extending over a series of years. The judgment of the investigator has had time to become mature.

The investigator has been wise in extending the effective period of his investigation backward by utilizing the work of those who came before him, by being careful to supplement their work rather than to supersede it. Similarly, he has greatly increased the forces brought to bear upon the problem by supplementing, rather than by attempting to supersede or to repeat, the work of contemporaries.

Mr. Abbot has evidently been keen and skilful in his search for the lines of least resistance, along which greatest progress may be made for a given expenditure of energy. His reward has been the unusual progress made.

These are some of the reasons for confidence in this research, for confidence that its only weak points are those pointed out by Mr. Abbot by cautious wording in the formal printed report.

It may be well to emphasize certain ideas, developed in this investigation, which help one to see the earth in proper perspective.

"The true radiating surface of the earth as a planet is chiefly the water vapor of the atmosphere at an elevation of 4,000 meters or more above the sea level." In other words, the man in the moon, when he looks at the earth, is, in general, blinded to the small contrasts in color on the surface of the earth by the light which comes to him from the air and its contents. He secures but fleeting glimpses of the outlines of the continents.

The layer of air 13,000 feet thick, with its load of other material, including water, is a great blanket of peculiar kind such that it allows the sun's radiation to penetrate downward through it more readily than it allows the radiation to return upward in the somewhat changed form in which it then exists. The result is that, while the radiating layer has a temperature of about —10° C. the surface of the earth is maintained at about 14° C.

It seems to be conclusively proved that the amount of the radiation sent to us from the sun varies 5 per cent. in each direction from its mean value. The variation is irregular, not periodic, and the intervals of marked excess or defect are only a few days or a few weeks, as a rule.

It was hoped, at the beginning of this investigation, that it might lead to the discovery of means of forecasting climatic conditions for some time in advance. The investigation shows that the 5 per cent. variation in the radiation produces only about 1° C. change in temperature at favorable inland stations and a fraction of a degree only at island and coast stations. This direct effect is, therefore, very small.

J. S. Diller,
Recording Secretary

Discussion and Correspondence

Wild Jamaica Cotton

To the Editor of Science: I send you herewith a letter from Dr. N. L. Britton, who is

now engaged in a botanical expedition in the West Indies. As you will see, Dr. Britton wishes to have the information in his letter published in SCIENCE. The seeds received from him were turned over to Mr. O. F. Cook, who has examined them and prepared a memorandum, a copy of which I enclose.

This most interesting cotton will be grown for comparative study with other Central American and West Indian cottons, which Mr. Cook is engaged in acclimatizing and breeding.

FREDERICK V. COVILLE

WASHINGTON, D. C.,
April 9, 1908

SCHOONER "NELLIE LEONORA"
Off Bluefields, Jamaica,
March 6, 1908.

MR. F. V. COVILLE,
U. S. Department of Agriculture,
Washington, D. C.

My dear Coville:

I am sending you by mail a small box of cotton, with seeds collected yesterday near Portland Point, Jamaica, by Mr. Wm. Harris and myself. We were very much interested in observing this cotton plant, which is growing in great abundance at that point in the extreme southern part of Jamaica, in coastal thickets both in sand and on nearly level limestone rock where there is scarcely any soil; we noticed it over an area about a mile long and several hundred feet wide. There is a total absence of weeds of cultivation, the cotton being associated with characteristic plants of the coastal lowlands. The flowers are small, the petals white with a crimson spot at the base, fading through the day to pink; the pods are small, nearly globular, the foliage pubescent or very nearly glabrous.

There are no white residents at the place; the negroes say that the cotton was brought there in slavery times and planted, but the soil is such that no cultivation would be practicable and the remarkable absence of weeds indicates that no cultivation was attempted there; the negroes say that it was formerly collected and shipped.

The occurrence of the plant at this place, associated only with native species, has given us a strong impression that it is indigenous, though it may not be; at any rate it is a race of cotton that has probably been quite unchanged from its pristine condition.

It at once occurred to us that this race might prove a very valuable one for breeding purposes, inasmuch as it furnishes a new point of departure. I therefore ask that you transmit the seeds sent by mail to such officer of the Department of Agriculture as will be most interested; I have good museum and herbarium specimens of the plant which we will share with you.

I ask also that you send a copy of this letter for publication in SCIENCE.

Yours very sincerely,
(Signed) N. L. BRITTON

Note on Professor Britton's Wild Jamaica Cotton

Professor Britton's account of the conditions under which this primitive type of cotton grows would seem to establish beyond doubt that it is really a wild plant. The very small bolls and sparse lint would seem to preclude the idea that this cotton was introduced into the island for civilized agriculture. If not truly indigenous it must have been brought in aboriginal times, or by accident.

The existence of wild cotton in Jamaica has been claimed by Macfayden and others, but the evidence has not been convincing. Macfayden described two species of cotton (*Gossypium jamaicense* and *G. oligospermum*) as native of Jamaica, but both are said to have yellow flowers and have been reckoned as forms of Sea Island cotton (*Gossypium barbadense*). White flowers are not known in any cottons of the Sea Island series.

In the characters of the seeds and bolls Professor Britton's cotton closely resembles a type which grows wild on the Florida Keys. Sir George Watt's recent monograph refers this Florida cotton and other reputed wild cottons from Florida, Jamaica, Curacao and other West Indian localities to *Gossypium punctatum*, a species originally described from Africa. The same author reckons *Gossypium punctatum* as one of several ancestors of our

United States upland varieties, because a few of our upland cottons have the red spots at the base of the petals. The argument is far from conclusive, for red spots occur in many widely different types, and are probably an ancestral character of the genus.

The seeds of this wild Jamaica cotton show a very interesting diversity. In addition to the lint a majority of them have a dense adherent covering of brown fuzz, but on some the fuzz has a dull greenish tinge, while in still a third group most of the surface is smooth and naked, the hairy covering being limited to a tuft of brown fuzz at the base of the seed, and a tuft of lint at the apex. The presence of all three conditions in the same lot of seeds of this primitive wild type of cotton may help us to believe that similar diversities inside our upland varieties do not, of necessity, prove hybridization, but may represent a normal range of ancestral diversity in this group of plants.

The usual correlation of greater length and smaller quantity of lint on smooth seeds also holds good. The lint from the smooth seeds averages 31.3 millimeters, that of the fuzzy seeds 30 millimeters. The lint represents 16.03 per cent. of the total weight of the smooth seeds, and 18.27 per cent. of the fuzzy seeds. The smooth seeds weigh, without the lint, at the rate of 4.23 grams per hundred, the fuzzy at the rate of 4.97 grams. If the fuzz were removed and weighed with the lint, the proportion of fiber to seed would appear still higher with the fuzzy seeds. The slight increase of length of fiber on smooth seeds is accompanied by a disproportionate reduction of the quantity of fiber.

O. F. Cook

THE CORROSION OF IRON

To the Editor of Science: In a recent publication under date of May 10, 1907,[1] entitled "The Corrosion of Iron," the writer discusses the possibility of using certain inhibitors in the priming coats of paints and other protective coverings. The suggestion was publicly made that slightly soluble chromates should be theoretically the best protectives to apply to iron and steel surfaces. Numerous chrome pigments have been tested by the writer in reference to their inhibition value, the work having been done in large part previous to the publication of the bulletin above cited. Owing to included impurities, many of the commercial chrome pigments have been found to stimulate rather than inhibit corrosion, and the use of these for such purposes should be carefully guarded against. It has been found, however, that zinc chromate and a pigment made by precipitating barium and calcium chromates in molecular proportions give excellent results in the absence of impurities, such as sulphates, chlorides, etc. Prussian blue has also proved itself among the best of the rust inhibitors, so that excellent formulæ can be devised for good greens, using the above pigments with small amounts of pure calcic carbonate, and magnesium silicates, etc. Certain of the basic orange chromates also give good results.

It has been reported that patents have recently been applied for on a combination of zinc chromate with linseed oil as an inhibitive coating for iron and steel. The details of the claims can not yet be known, but in view of the general publication of the writer's results, it does not seem that the grant of such a patent would be justified. It is the policy of this department to give out the information it obtains for the free use of every one in the country, and particularly to safeguard the interests of the farmers. It would be a misfortune, in case these inhibitive formulæ prove themselves of high protective value, that their general use should be tied up by individual patent claims.

Allerton S. Cushman
Office of Public Roads,
U. S. Department of Agriculture

[1] Bulletin No. 30, Office of Public Roads, U. S. Department of Agriculture.

THE DISCOVERY OF THE SATELLITES OF MARS

To the Editor of Science: In its issue of November 26, 1907, the Boston *Evening Transcript* published an article on the late Professor Asaph Hall, U. S. Navy, by John Ritchie. This paper contained the following

statements; the first concerning the discovery of the satellites of Mars:

> It was an accidental discovery, interesting because it concerns the system of our nearest neighbor in space, useful because it has furnished a new means of considering certain problems in astronomy, but not to him a crowning achievement.
>
> He was not easily carried away by any of the psychological waves that come and go in astronomy. During one of these at the Naval Observatory it was quite the fad to observe the companions of a certain well-known star. Each man, it proved, had his own companion that he thought he saw, and comparison showed later that no two had the same one. Only Hall of all the staff resisted the opportunity, and only he, it afterwards proved, was right, for all of the little companion stars were of the imagination.

The above statements were so inconsistent with the facts that I wrote to the editor on December 4, 1907, giving him a brief but true account of the matters at issue, asking that my communication be given as wide a circulation as was given to the incorrect article. It was not printed. When asked if my article had been received the editor replied, on December 17, that it had, and had been referred to the author of the article printed November 26, 1907. Nothing has since been heard from the editor or the author, and apparently neither is willing that the facts be known. Therefore, in the interest of truth and also of justice to Professor Hall I ask that the following comments on the *Transcript* article be printed in SCIENCE.

The statement that the discovery of the satellites of Mars was an accident is not only entirely without foundation but it is unjust to the professional reputation of Professor Hall. I knew Professor Hall intimately, had worked in the same building with him for fifteen years, we lived in adjoining houses and we walked together to and from the observatory nearly every day and frequently at night. His scheme for observing Mars was discussed with him in these walks and in his home, and I know that the discovery was the definite result of a carefully devised plan for an exhaustive search for satellites. At the time of the discovery an effort was made to divert the honor of the discovery from Professor Hall, but, fortunately, that attempt failed. To say now that the discovery was an accident is a wide departure from historic truth.

With regard to the statements: "it was quite the fad to observe the companions of a certain well-known star"; "each man had his own companion that he thought he saw," and "only Hall of all the staff resisted the opportunity," it may be said, briefly, that they are absolutely untrue. None of the trained observers of the Naval Observatory saw these "companions." The discovery of these companions was made by an amateur, not a member of the observatory staff. The note books of that period will show the folly of the statement in the *Transcript*.

Another recent statement concerning the discovery of the satellites of Mars may be mentioned in this connection. In the March number of the *Cosmopolitan* magazine, page 343, Professor Todd, of Amherst College, tells a curious story of the discovery of Phobos, the inner satellite of Mars. He writes: "So mine was the first human eye that ever saw Phobos, recognizing it as a satellite."

This statement is remarkable in two ways: First, because this information has been withheld from the public and from astronomers for thirty years and only published after the death of Professor Hall; second, the statement will not deceive trained astronomical observers, but the general public ought to know that *before* and *since* that event it has been impossible for an astronomer to recognize the difference between a small star and a satellite, near the limit of vision, without extended observation or careful measures, which were not employed at the time mentioned in the magazine.

JOHN R. EASTMAN,
Professor of Mathematics
U. S. N. (retired)

ANDOVER, N. H.,
April 2, 1908

SPECIAL ARTICLES

PRE-CAMBRIAN SEDIMENTS AND FAULTS IN THE GRAND CANYON OF THE COLORADO[1]

THE work of Powell, Walcott and others

[1] Published by permission of the director of the U. S. Geological Survey.

has familiarized geologists with the great horizontal wedge of Proterozoic (Algonkian) sediments which thins out to the west just south of Vishnu Temple, but there is nothing in the literature of the Grand Canyon which prepares the visitor for encountering a mass of the same sediments some ten miles west of Vishnu Temple and directly opposite the hotels at the end of the Grand Canyon Railroad.

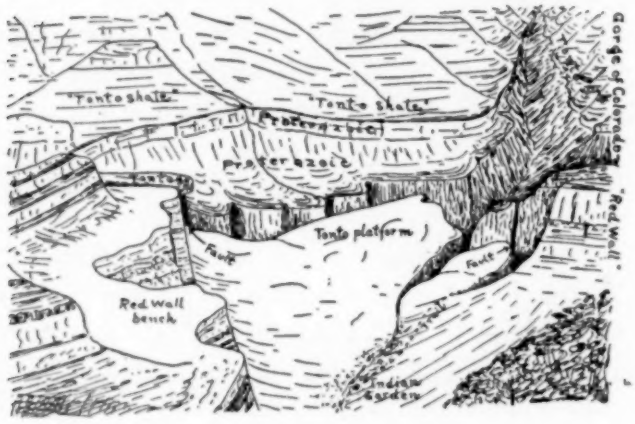

Fig. 1. Sketch from Bright Angel trail looking northward across the inner gorge of the Colorado and up Bright Angel Creek. The Bright Angel fault is shown on the right crossing a spur of gneiss capped by a small mass of Proterozoic sediments.

Doubtless other eyes than mine, practised in geological observation, have recognized the Proterozoic rocks in that part of the northern wall of the canyon lying just west of Bright Angel Creek, for the beds are visible from El Tovar hotel. It seems appropriate, however, that there should be published some accessible note calling attention to the interesting features there displayed, for the benefit of the thousands of people not necessarily geologists, who study with intelligent interest this, the most frequented part of the great chasm.

Although the general relations of the Proterozoic rocks can be made out from the southern rim of the canyon they may best be studied from the edge of the Tonto platform just west of Pipe Creek and overlooking the inner gorge—a vantage point easily gained by leaving the traveled Bright Angel trail at Indian Garden and walking or riding northward over the comparatively smooth upper surface of the Tonto sandstone (see Fig. 1). From this place the structure shown in the accompanying section (Fig. 2) is superbly displayed. The long straight gorge of Bright Angel Creek coincides with a fault of which the throw is at least 300 feet, the west side being relatively depressed. This fault-zone is visible at many points on the south side of the canyon, being crossed and recrossed by the Bright Angel trail as it zigzags down the steep slopes of gneiss along Pipe Creek. On the east side of the gorge the much contorted, truncated, Archean gneiss is capped by horizontal "Tonto sandstone" conformably overlain by the "Tonto shale" and the "Red Wall limestone"; on the west side the red sandstones and shales of the "Unkar terrane" rest, also uncomformably, upon the Archean with a low dip to the east. About two miles west of the mouth of Bright Angel Creek the pre-Cambrian sediments are cut off by a second fault which, as shown in the section and sketch, does not displace the overlying "Tonto sandstone."

A partial and brief summary of the history of events recorded in this section is as follows: (1) The reduction of the Archean rocks to a plain of erosion. (2) The deposition of the Proterozoic sediments, (3) Faulting, by which a mass of the sedimentary rocks was inset into the Archean. (4) Peneplaination of the region. At the end of this erosion period, part of the inset block of pre-Cambrian rocks was left as a low monadnock above the general

Fig. 2. Diagrammatic section of part of the north wall of the Grand Canyon near the mouth of Bright Angel Creek. Vertical and horizontal scales the same.

level. (5) The deposition of the Cambrian "Tonto sandstone" (which, however, did not cover all of the Proterozoic monadnock), succeeded by the accumulation of the "Tonto shale," "Red Wall limestone" and later Paleozoic formations.

It is clear that the present vertical distance between the pre-Tonto and pre-Unkar unconformities affords only a minimum measure of the throw of the pre-Cambrian faults. That there has been some slight post-Paleozoic movement along the Bright Angel fault, enough to fissure the "Red Wall" and "Aubrey" formations, is shown by the erosion of the Bright Angel gorge, the alcove of Indian Garden, and the shallow drainage trench followed by the Grand Canyon Railroad near the southern rim of the canyon. As may be seen from the Bright Angel topographic sheet of the U. S. Geological Survey, the three features mentioned together constitute a remarkable rectilinear depression at least 20 miles in length.

F. L. RANSOME
WASHINGTON, D. C.

AN EARLY FIGURE OF THE KING-CRAB (LIMULUS POLYPHEMUS)

THERE has recently been placed on exhibition in the gallery of arthropoda in the Zoological department of the British Museum a copy of a water-color drawing made about 1585 and containing what is believed to be the earliest representation of the American king-crab (*Limulus*, or *Xiphosura, polyphemus*). As the subject is one of special interest to American naturalists, it may be worth while to place on record here some of the facts relating to it.

The original drawing was made by John White, who was one of the first settlers in, and for some time governor of, Virginia, and acted as lieutenant to Sir Walter Raleigh on several voyages to North America. Three volumes of drawings by him are preserved in the Department of Prints and Drawings in the British Museum, and have recently been described in detail by Mr. Laurence Binyon in the fourth volume of his "Catalogue of Drawings by British Artists . . . in the British Museum" (1907, pp. 326–337). Many of White's delineations of natural objects are of great beauty and show a fidelity to nature which was very rare at the period when they were executed.

The drawing in which the figures of the king-crab are introduced is a view of Indians spearing fish, and two specimens of *Limulus* are roughly but quite unmistakably sketched among shells and other marine objects lying on the beach in the foreground. Like many of White's drawings this one was engraved for de Bry's "America"[1] in 1590. In the engraving the figures of the king-crabs, like some other portions of the picture, are drawn in somewhat greater detail, suggesting that the engraver was working from some other drawing now lost. As Mr. Binyon suggests, "doubtless White made many repetitions of drawings which would have such lively interest for his countrymen." In de Bry's volume the text accompanying these drawings is a translation of Thomas Harriot's "A Brief and True Report of the New Found Land of Virginia, &c.," first published in 1588 and afterwards reprinted in Hakluyt's "The Principal Navigations, &c." in 1598 (the following quotation is from the Hakluyt Society's edition, 1904, Vol. VIII., p. 370). In his list of the natural products of Virginia Harriot mentions "Seekanauk, a kinde of crusty shel-fish, which is good meat, about a foot in bredth, having a crusty taile many legges like a crab, and her eyes in her backe. They are found in shallowes of waters and sometime on the shore." This doubtless refers to the king-crab. It would be interesting to know whether any readers of SCIENCE can give a reference to any earlier mention of this animal.

W. T. CALMAN
BRITISH MUSEUM (NATURAL HISTORY),
LONDON,
January 7, 1908

[1] Grands Voyages, Part I., pl. 13.

A PLAN FOR INCREASING THE EFFICIENCY OF MARINE EXPEDITIONS

APART from their work in deep-sea sounding, and in the accumulation of meteorolog-

ical observations, marine expeditions of the past have been merely extensive collecting trips. Only few and unimportant studies of living forms are possible upon a ship at sea, and practically all of the animals and plants collected are thrown immediately into preservative fluids in order that their more or less distorted remains may be sent ashore for distribution among specialists of research. In anthropology, geography, geology and kindred sciences the results are hardly more satisfactory, for it is only rarely that a vessel can remain in any one port long enough to enable her scientific staff to do more than make a mere reconnaissance.

Yet modern science is being advanced by intensive and accurate, not by extensive and cursory, observations. As time goes on the superficial in science commands less and less of our respect; and yet after an expenditure of millions by all civilized nations upon a score of marine expeditions we find that these projects have achieved practically nothing in the advancement of physiology, embryology, cytology, ecology; or in any studies requiring that plants or animals be maintained alive for any considerable time, or that use be made of the complex processes of experimentation in vogue in the modern laboratory.

My own experience, which results from having been upon many marine expeditions in all of the great oceans, forces me to conclude that not more than one fifth as much work can be accomplished on ship-board as is possible even in a moderately well-equipped land station. Really good days at sea are rare, and too often occur when the vessel must either lie idle, hasten toward some distant port, or be otherwise prevented from carrying out scientific studies. Even if one be not affected by sea-sickness, the constant rolling of the ship, shaking due to engines, and uncertain fluctuations of light in the laboratory are most discouraging to accurate work.

In future let us establish temporary land stations for the scientific staff and use the ship to supply such laboratories with their equipment and with material for study as it travels from station to station in accordance with the requirements of its work.

Only a few years ago such a plan would have been impracticable, but within the past five years the naphtha engine has been so far perfected to marine use, and so many sailors have become trained to its management, that it now gives us an opportunity to provide each temporary land station with a fast-moving collecting boat always ready for immediate service and capable of exploring every detail of coast or ocean current within a radius of many miles.

Moreover, the modern perfecting of easily transported portable houses which can readily be erected on barren shores, and the great variety one may now obtain of preserved foods, render it possible to house and supply investigators in temporary stations in regions which only a few years ago were practically inaccessible.

The marine expeditions of the future should, I think, aim to establish well-equipped but temporary shore stations at salient points, landing investigators here and there and leaving them with servants, food, lodging, apparatus and naphtha launches to avail themselves of all the varied advantages afforded by a land laboratory. In this manner a larger number of investigators than is at present possible could be carried on the expedition; for most of them would make use of the vessel merely for transportation from station to station, and for necessary supplies. A small staff permanently resident upon the steamer itself would suffice for the prosecution of such deep-sea studies as must needs be accomplished while at sea.

There is sufficient room upon any sea-going vessel for the transportation of several portable houses, half a dozen or more naphtha launches, and for collectors, engineers, sailors and cooks required for the service of the various shore stations.

Such a plan would not interfere with the constant use of the ocean-going vessel itself, which could readily carry out her proper scientific work while traveling from station to station, either to remove parties of investigators to other sites or to provide them with specimens or supplies.

We see, then, that this plan has the double

advantage that it enables the expedition to carry many more investigators than if all were to remain constantly on board, as of old; and it also greatly widens the scope and increases the efficiency of their individual researches.

There are many problems, yet awaiting solution, which previous marine expeditions have either been obliged to neglect or have studied in a superficial and unsatisfactory manner. Such are:

1. The determination of the depth of the "red clay" which covers the floor of the deepest parts of the open oceans. Since the oceans ceased to boil this deposit has been gathering upon the floor of the deep sea, and a determination of its depth would enable us to form an approximate estimate of the age of the oceans themselves.

2. The character of and influences affecting ocean currents, especially at considerable depths.

3. The embryology of numerous creatures of the open ocean and of the deep water, such as *Nautilus,* the trachylina medusæ, etc.

4. A more accurate and intensive study of the nature and origin of coral atolls.

5. A more accurate study of the phenomena of oceanic volcanic islands.

6. A comparative study of the distribution of life over the great oceans; both near the surface, and at the bottom, over the open sea and in the neighborhood of coasts.

7. An intensive study of the arts, legends and habits of the native races of relatively inaccessible regions.

8. A more accurate study of meteorological conditions, leading to a more perfect understanding of the nature of the trade winds, tropical hurricanes, etc.

The nature and scope of the problems must, however, be determined by the capacities and training of those constituting the scientific staff of such an expedition. With a wisely selected corps of able, energetic students more might be accomplished upon an expedition planned in accordance with this which we have here crudely outlined, than has resulted from even the most expensively equipped marine expeditions of recent years, all of which have adhered to the old plan of attempting to constitute of the vessel a floating and traveling laboratory.

ALFRED GOLDSBOROUGH MAYER

THE MARYLAND GEOLOGICAL SURVEY

THE Maryland legislature, which adjourned a few days ago, provided $1,000,000 for the work of the State Geological Survey during the coming biennial period—$50,000 for the geological investigations, topographic surveying, and maintenance of the testing laboratory; $150,000 for the continuation of the construction of the Baltimore-Washington road, and $800,000 for the work under the State Aid Highway Law, one half of the latter to come from the state treasury and one half from the county treasuries. Under the State Aid Law the roads must be built in accordance with the plans and specifications and under the supervision of the engineers of the Geological Survey.

The Mayland legislature also passed a bill providing for a bond issue of $5,000,000 for the construction of a main artery system of state highways 1,000 miles in length during the next five years, $1,000,000 to be available each year. A long and bitter fight developed over the administration of this new fund, the senate desiring it placed in the hands of the State Geological Survey and the house wishing a new commission. Just as the legislative session was closing a compromise was effected by which a new commission of six members was provided for, three to come from the Geological Survey. The understanding reached was that Governor Crothers, President Ira Remsen, of the Johns Hopkins University, and Dr. Wm. Bullock Clark, director of the State Geological Survey, should be selected to represent the survey. It was also agreed that after this new commission had designated the 1,000-mile system the roads should be turned over to the Geological Survey for construction. The leading newspapers of the state, including all of the daily papers of Baltimore, strongly advocated the placing of the work under the Geological Survey, where it would be effectively managed and free from political influ-

ence. The leading business bodies of Baltimore and the farmers' organizations throughout the state passed resolutions to the same effect. No subject before the Maryland legislature this past winter occasioned such widespread interest.

The Maryland Geological Survey began highway work ten years ago with the establishment of a highway division and has gradually developed the public interest that has made possible the present progressive highway movement in that state. Four years ago the State Aid Highway Law was passed and two years later an appropriation was made for commencing the construction of the Baltimore-Washington road under the Geological Survey. This is the first instance on record where a state geological survey has been entrusted with a great public work of this character and it is a matter of no small interest that a bureau which has been successfully maintaining its scientific work has at the same time secured the support of the people of the state in the largest undertaking in its history.

INTERNATIONAL CONGRESS FOR THE SUPPRESSION OF ADULTERATION

The general committee of organization of the First International Congress for the Repression of Adulteration of Alimentary and Pharmaceutical Products, to which attention was called in your issue of March 20, 1908, has published the following additional items respecting the work of the congress:

The committee particularly asks from chemists a report of general interest on any subject of their own choice relating to the principal topic of the congress or a report treating of special questions entering into the restricted elements of one of the eight sections of the congress.

The committee further asks of all manufacturers and dealers definite notes indicating, in the group of foods or drugs which most specially interest them: first, the frauds and adulterations of which they have most to complain; second, the measures of protection they ask for; third, criticisms of the laws and regulations in force; fourth, the additions, viz., coloring matters, preserving agents, etc., which they ask to be authorized for their products or which they complain of seeing authorized.

The committee further asks that there be forwarded as soon as possible the titles of papers which are to be sent from the United States, the whole paper or abstract thereof to follow later. Inasmuch as the congress is fixed to begin on the eighth of September, it is important that American contributors do not delay in preparing the reports they wish to present. I further urge all who are intending to prepare papers for the congress to send me their titles without delay in order that they may be transmitted to the general committee.

The general committee also gives notice that the exhibition of pure and adulterated foods and drugs which it was intended to prepare has been postponed on account of the short time intervening before the opening of the congress.

I extend a second invitation to American chemists, manufacturers and dealers to subscribe to the congress, and will gladly undertake to forward such subscriptions, if sent to me at Washington. As before stated, the subscription price for an ordinary member is $4 and for a donating member $20. I am pleased to add that I have already received and forwarded to Geneva a goodly number of subscriptions of American members.

H. W. Wiley,
President of the American committee and vice-president of the congress

CORRESPONDENCE IN REGARD TO THE PENSIONING OF WIDOWS OF PROFESSORS BY THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING

Columbia University
Division of
Philosophy, Psychology and Anthropology
Garrison-on-Hudson, N. Y.,
March 21, 1908

President Henry S. Pritchett, LL.D.,
The Carnegie Foundation for the Advancement of Teaching, New York City

Dear Dr. Pritchett:

May I venture to ask whether Provision (6) under the rules adopted for the granting of normal retiring allowances by the Carnegie

Foundation applies to all cases in accepted institutions? It reads: "Any person who has been for ten years the wife of a professor in actual service may receive during her widowhood one half of the allowance to which her husband would have been entitled." This provision might mean that all widows of this class would receive the retiring allowance on proper application, or it might mean that the allowance may, or may not, be granted after recommendation of the president of the institution concerned and consideration of the merits of the professor and the needs of his widow. I fear that the latter interpretation is correct, but I trust not, as it would seriously interfere with the position of the Carnegie Foundation as an agency for promoting the dignity and honor of the teaching profession.

In your annual reports you have wisely emphasized the fact that the Carnegie Foundation is not a charity, but an educational agency. You say: "No body of men is wise enough to administer a system of pensions upon considerations of individual merit only, without a strong probability that the administration will in the end degenerate." Does this not apply to pensions for widows, as well as to annuities? It appears to me that most healthy-minded men are more concerned with provision for their families in case of disablement or death than with anxiety as to their own old age. I sympathize with those who take out life insurance, not with those who buy annuities, and it gives me no satisfaction to be put by force of circumstance into the latter class. I should like to exchange my annuity for life insurance of equal value, and I believe that this would be the nearly unanimous preference of my colleagues.

The Carnegie Foundation adds substantially to the incomes of accepted universities and colleges, but it does not greatly assist the individual professor. The provision for retirement for age does not help at all in institutions that already had a pension system; in other accepted institutions the salaries will be adjusted with reference to the pension, and the only individuals who benefit are some of the older men in institutions without a pension system for whom the benefit is retroactive. Apart from this group, the benefit to the individual—and only until readjustment of salaries takes place—is confined to the length of service provision, the wisdom of which is doubtful, and the widow's pension, which only applies at the age when it is least needed, and if administered as a charity would in the long run be, as you say, "sure to harm rather than to help the teacher and the cause of education."

If the professor must be the *Versuchstier* of paternalism, is not the German system—by which he receives his salary for life, being relieved from service if disabled by illness or old age, and his widow and each of his minor children receive a pension—the best plan both for the professor and for the university? And, if so, could not the Carnegie Foundation bring about this system by offering endowments to those institutions that would adopt it?

May I print in SCIENCE this letter and your reply? Very truly yours,

J. McK. CATTELL

Office of the
President
THE CARNEGIE FOUNDATION
FOR THE ADVANCEMENT OF TEACHING
576 Fifth Avenue
New York

March 24, 1908

DEAR PROFESSOR CATTELL:

Your letter of March 21 I can answer with more definiteness after next Tuesday, when the matter of widow's pensions is likely to be put upon a completely definite basis. I will, therefore, delay my answer until next week, when I will endeavor to answer your questions completely. Very sincerely yours,

HENRY S. PRITCHETT

Professor J. McKeen Cattell,
Garrison-on-Hudson,
New York

Office of the
President
THE CARNEGIE FOUNDATION
FOR THE ADVANCEMENT OF TEACHING
576 Fifth Avenue
New York

April 13, 1908

DEAR PROFESSOR CATTELL:

I beg to acknowledge the receipt of your

letter of March 21, the answer to which has been delayed by an unusual pressure of work.

As you state in your letter, our rule relative to the widow of a professor does not now definitely assure her of a pension. The executive committee has, however, voted to recommend to the trustees that this rule be amended by changing the word "may" to "shall." I have no question that this action will be taken.

I regret that it seems to you that the Carnegie Foundation does not assist the individual professor, but adds to the income of universities. I do not think this view justified, nor is it one which the foundation seeks to promote. We are just issuing a bulletin giving the financial status of the American professor and making clear the fact that it is the effort of this agency not only to bring to the teacher's profession a greater security, but, so far as it can, to assist in giving a more adequate salary. I believe that this will be its effect.

The provision for permitting a retiring allowance to be gained upon length of service seems also to us to add much to the value of the retiring allowance system. Under this provision a professor may, at the end of twenty-five years, retire on a stated proportion of his salary, the proportion increasing with each year of service. It is not likely that many professors will avail themselves of this provision. The man whose heart is in his teaching will not wish to give it up until a much later period. There are, however, teachers to whom this provision will be specially attractive, and that is to those who desire to spend the remainder of their active lives in scholarly research or literary work rather than in teaching. I can imagine no better thing for an institution of learning than to have about it a group of men who are engaged in active research and who are not burdened with the load of teaching which falls to most American teachers. In this way the retiring allowance will contribute directly to research.

A retiring allowance system, to be effective in the case of a profession like that of teaching, ought to do at least three things: (1) furnish a temporary salary in case of illness; (2) guarantee a fair proportion of the active pay as a retiring salary upon the completion of a certain service or upon arriving at a certain age; (3) guarantee a pension to the widow of a professor who has himself earned a retiring allowance. The system of retiring allowances established by the Carnegie Foundation does all these things and I can not but believe that to give this security to the teacher's calling will add to its dignity and attract to it good men. Furthermore, I am sure that these results will be brought about without a diminution of salaries which could otherwise be obtained. Yours sincerely,

HENRY S. PRITCHETT

Professor J. McKeen Cattell,
Garrison-on-Hudson,
New York

COLUMBIA UNIVERSITY
DIVISION OF
PHILOSOPHY, PSYCHOLOGY AND ANTHROPOLOGY
GARRISON-ON-HUDSON, N. Y.,
April 17, 1908

PRESIDENT HENRY S. PRITCHETT, LL.D.,
The Carnegie Foundation for the Advancement of Teaching, New York City

DEAR DR. PRITCHETT:

I learn with much pleasure of the action of the executive committee of the Carnegie Foundation in recommending that the pensions of widows shall hereafter be a matter of right and not of charity, and I am gratified if my letter had something to do with this. I trust that it will be followed by a similar provision in the case of disability. You say in your letter that the foundation furnishes a temporary salary in case of illness. This, however, is not as yet a matter of right and contract, but of favor; and, as it now stands, the dangers appear to more than counterbalance the advantage to certain individuals. We need especially insurance against disability, as this is not provided, as are life insurance and annuities, by commercial enterprise. It is of course his wife and children, not himself, which make disability such a serious matter to the professor. His capital is his ability and his

education. If it is lost as a direct consequence of attendance to his duties, we have the best warrant for special provision.

The whole question of enforced pensions is endlessly complicated, the conflict between individualism and socialism being the most pressing of our civilization. It seems self-evident that if part of the salary of a professor is paid in the form of an old-age annuity, he must receive so much less salary at the time. It costs the same to pay a professor $3,500 a year, or $3,000 plus an annuity, the annual expense of which is $500. The question is which is better for the professor and for society. The Carnegie Foundation descending, as it were, suddenly from heaven is certainly a windfall for a professor in an institution that did not have a pension system—perhaps he would like it still better if he were paid the cash value of his annuity, which in some cases would be as much as $20,000. The foundation is also a godsend to the college president, the income of whose institution is generously augmented.

But these present gains to the individual may obscure our appreciation of what will happen twenty years hence. Our educational system will be richer by the income of $15,000,000; but will the professor be better off because part of his salary is paid in the form of an enforced annuity? There are obvious advantages to the individual, to the institution and to society; but there are also difficulties and dangers. If we are to have an extension of paternalism, it appears that it should apply first to children and to the ignorant, rather than to university professors. Economic socialism may be inevitable and even desirable, but we must try to maintain intellectual and moral individualism. If we make an economic caste of university professors and put it under the care of a board of university presidents, the outcome may be a deadening of intellectual vigor and moral freedom in the university.

In accordance with your kind permission I shall print this correspondence in SCIENCE.

Very truly yours,

J. MCK. CATTELL

ACADEMIC FREEDOM IN AUSTRIA

WE learn from the London *Times* that the professorial senate of Vienna University has issued a pronouncement in regard to the case of Professor Wahrmund, of Innsbruck, which deals with the questions whether a professor of canon law can be deprived of his chair in the juridical faculty of a state university if he comes into conflict with the doctrines of the Roman Catholic Church, and whether it is admissible that the church should exercise control over the agreement of his teachings with her doctrine. It holds that if the principle that the teachings of a professor must coincide with religious doctrine were to be recognized, no department of human knowledge would remain unaffected, since all departments of knowledge have some bearing upon religious doctrine, and concludes that, inasmuch as a mere adroit attempt to influence the exercise of the right of the state or superintend the universities might in future introduce ecclesiastical influences into the management of the universities, the academic senate considers "inflexible resistance to efforts of this kind, however they may be made, to be a necessity enjoined by the vital principles of science." Professor Wahrmund has been requested by his colleagues of Innsbruck University to suspend his lectures for the time being, lest academic disturbances necessitate premature closing of the university.

PREDATORY POLITICS IN OKLAHOMA

MANY of our state universities and state educational systems have passed through a period of predatory politics. Fortunately, the good sense of the people must in the end prevail, and the more important the institution, the less danger is there from the methods of the ward politician. We regret that it is now the fate of the new state of Oklahoma to suffer disgrace in the hands of its politicians. Every republican has been deposed by the democrats from the head of the state institutions, including the University of Oklahoma, the College of Agriculture and the Mechanic Arts, the University Preparatory School, the Central State Normal School, the Northwest-

ern State Normal School and the Southeastern State Normal School. We are tempted to print as a roll of dishonor the names of the Democrats who have accepted these positions, but this might be unjust in special cases.

SCIENTIFIC NOTES AND NEWS

Dr. William H. Walker, professor of technical chemistry at the Massachusetts Institute of Technology, has been presented by the New York Section of the American Chemical Society with the Nichols medal.

The Rumford medal of the American Academy of Arts and Sciences has been awarded to Dr. Edward G. Acheson, of Niagara Falls, for his work with the electric furnace. The Rumford committee of the academy has made the following grants. To Dr. Lawrence J. Henderson, of the Harvard Medical School, $200—in aid of his investigation upon the direct determination of physiological heats of reaction. To Professor Joel Stebbins, of the University of Illinois, $100—for his investigation on the use of selenium in photometry. To Mr. Willard J. Fisher, of Cornell University, $100—for his investigation on the viscosity of gases.

We noted last week the banquet at the Hotel Astor on April 9, to celebrate the silver jubilee of Dr. H. W. Wiley as chief chemist of the U. S. Department of Agriculture. On the following day in Washington a banquet was tendered Dr. Wiley by the chemists and scientific assistants who have been associated with him in the work of the Bureau of Chemistry in expression of their loyalty and good will.

Professor Raymond A. Pearson has resigned the chair of dairy industry at Cornell University to become New York state commissioner of agriculture.

The Observatory states that Mr. R. H. Tucker, now of Lick, has been offered the directorship of the proposed Southern Observatory to be established by the Carnegie Institution either in New Zealand, South America or South Africa, for the purpose of making observations of position of stars of the southern hemisphere, according to a scheme suggested by Professor Lewis Boss, of the Dudley Observatory. The Pistor and Martins meridian circle of that observatory is to be transferred to the new establishment.

The directorship of the Toulouse Observatory, vacant by the appointment of M. Baillaud to the National Observatory, has been filled by the election of M. E. Cosserat.

M. Henri Deslandres, who since 1897 has been assistant director of the observatory at Meudon, has been appointed director to succeed the late Dr. Janssen.

The Town Council of West Ham, London, has passed a resolution authorizing the placing of a bronze tablet on the house in Upton Lane, Forest Gate, now St. Peter's Vicarage, where Lord Lister was born.

We have noted the election of Professor A. A. Michelson as honorary member of the Royal Irish Academy. The other honorary members elected at the same time in the division for natural science are: Sir Archibald Geikie, Professor J. C. Kapteyn, Professor J. D. van der Waals and Dr. A. R. Wallace.

Dr. C. F. Brackett, Henry professor of physics at Princeton University since 1873, has resigned the chair and has been appointed professor emeritus.

Professor Boyd Dawkins has resigned the chair of geology at the Victoria University, Manchester, which he has held since the year 1874. In accepting the resignation the council expressed the great regret its members felt at the professor's retirement from the chair, which he had held with such distinction and with such benefit to the university. It was gratifying to the council to know that Professor Dawkins would retain his association with the Manchester Museum, where he had done valuable work, and would also continue his popular lectures and special courses of lectures.

We learn from *Nature* that Professor P. J. White having been granted leave of absence for six months on account of ill-health, the senate of the University College of North Wales has appointed Dr. W. A. Cunnington

acting head of the department of zoology for the summer term.

DR. WALLACE W. ATWOOD, of the University of Chicago, will spend the coming field season in Alaska, continuing his investigations under the auspices of the U. S. Geological Survey of the coal resources of Alaska. The special fields of work during the coming season will be in the neighborhood of Unga, Herendeen Bay and Chignik on the Alaskan peninsula, and in the Matanuska valley at the head of Cook Inlet. His address during the summer season will be Seward, Alaska.

THE Martin White studentship of £100, at London University, lately vacated by Mr. Gerald Camden Wheeler, B.A., has been extended to him for a further period of one year, in order to enable him to accompany Dr. Rivers to the Solomon Islands for the purpose of investigating the sociology of a mother-right community. This extension was rendered possible by the generosity of Mr. Martin White in offering to provide a further sum of £100 for the purpose.

DR. W. G. MACCALLUM, associate professor of pathology in the Johns Hopkins University, lectured before the faculty and students of the College of Medicine of the University of Cincinnati and many physicians of the city on April 17. He spoke of his recent research, including his discovery of the function of the parathyroid glands.

DR. L. A. BAUER gave an illustrated address on the "Magnetic Survey of the Pacific Ocean by the Carnegie Institution of Washington," on March 10, before the Scientific Association, Wesleyan University, Middletown, Conn.

ON Friday evening, April 10, Professor David Todd, of Amherst College, lectured before the Stamford Scientific Society on "Mars, as seen from the Andes."

AT a technical conference of the faculty and student officers of United States Army Signal School, at Fort Leavenworth, Kans., held on March 25, a resolution was adopted in the name of the school favoring the adoption of the word *Kelvin* to designate the commercial unit of electrical energy at present known as the *kilowatt-hour*, as a recognition of the services of the late Lord Kelvin in the advancement of electrical science.

THE body of Emmanuel Swedenbourg has been removed from the Swedish church in London, where it was interred on his death in 1872, and taken by a Swedish man-of-war to Stockholm, where it will be interred.

DR. G. VON HÜFNER, professor of physiological chemistry at Tübingen, has died at the age of sixty-seven years.

THE death is announced of Professor J. L. Mierzejewski, who has been called the father of Russian psychiatry. He published extensively on insanity, neurology and pathological anatomy.

SIR COWASJEE JEHANGHIR has given four lakhs of rupees (about $130,000) for the promotion of science teaching in Bombay.

THE city council of Lincoln has passed a resolution which gives the Nebraska State Historical Society a half block of ground facing the capitol upon which to erect the building provided for by the last legislature. Mr. Charles H. Morrill, of Lincoln, has presented to the society valuable collections of objects of Indian archeology.

THE Royal College of Surgeons of England has presented to the Harvard Medical School, through Dr. Walter G. Chase, about seventy engravings and mezzos of celebrated medical men. These, together with loan collections of Dr. Chase and Dr. E. B. Young, numbering about six hundred, have been arranged for exhibition in the Warren Anatomical Museum, in the administration building of the Harvard Medical School, Longwood Avenue.

PROFESSOR JOSEPH JASTROW'S work, "The Subconscious," has been translated into French by Mr. E. Phillipi, with an introduction by M. Pierre Janet, and is published in Alcan's Bibliothèque de Philosophie Contemporaine.

A REUTER telegram from Rome states that the International Congress of Mathematicians was opened on April 6 at the capitol. Signor Rava, minister of public instruction, the mayor of Rome, Signor Blaserna, vice-presi-

dent of the senate, the rector of the University of Rome, Professor Volterra, the mathematician, and a numerous body of the members of the congress from all parts of the world were present at the ceremony. The mayor welcomed the members in the name of the city of Rome, Signor Blaserna in the name of the academy and Signor Rava in the name of the government. Professor Volterra made the opening speech.

THE proposal for the establishment of an International Sickness Bureau having fallen through, at any rate for the time being, the British government has decided to take independent action, and it has been determined to establish a British national bureau in London, to be maintained by annual grants made from the imperial and Soudanese governments.

THE International Peace Bureau, Berne, Switzerland, has issued a circular letter embodying the resolutions adopted by the sixteenth Universal Peace Congress, which met at Munich in September, 1907. The substance of the resolutions is as follows: (1) That Esperanto be taught as an international auxiliary language in the schools; (2) that, inasmuch as the French minister of public instruction is disposed to initiate an intergovernmental conference to consider the best means of organizing an international system of education, and since the adoption of this system would entail the elaboration of programs which would enable students to pass from the institutions of one country to those of another with suitable diplomas, the congress expresses the hope that the different governments will speedily indicate their willingness to participate in this conference, and invites the "pacifistes" (or promoters of peace everywhere) to take the necessary steps to bring this about. (3) The congress, considering the importance of the measures taken, two years since, by the Italian minister of public instruction, which were also adopted by the Hungarian minister, to have all the pupils of the state schools participate in a peace festival on February 22, with a view to inspiring them with sentiments of peace and humanity, extends its felicitations to the governments of Italy and Hungary, and wishes to bring their beneficent example to the attention of all peace societies in order that through their instrumentality their own governments may adopt similar measures.

THE public lectures of the University of Cincinnati ended March 26, the last being "Civic Opportunities for Educated Women," by Miss Sophonisba Breckenridge, instructor in household administration and assistant dean of women in the University of Chicago. The preceding titles and lectures were as follows: "The Hygiene of Woman's Employment," Professor C. A. L. Reed; "Local Self-government in Cities," Dean William P. Rogers; "The Rôle of School and Workshop in the Production of Deformities," Professor A. H. Freiberg; "The Force of Ideas," Professor B. B. Breese; "Modern Hospitals," Professor C. R. Holmes; "Pragmatism," Professor H. H. Bawden; "Expert Testimony," Professor Joseph Ransohoff; "Fair Play for People and Corporations," Milo R. Maltbie, of the Public Service Commission of New York; "The Nature of Political Corruption," Professor Robert C. Brooks, of Swarthmore College; "Bacteria and Disease," Professor John E. Greiwe; "Petra, and the New Way Thither," Professor P. V. N. Myers, late of the University faculty.

A PRESS bulletin of the Forest Service calls attention to the fact that on the Pacific coast, especially in Oregon and California, there is an immense amount of white fir (*Abies concolor*) timber now going to waste for lack of some commercially profitable means of disposing of it. At present it is very little used for lumber, and since it is not cut to any extent its proportion in the forest tends to increase at the expense of other and more valuable trees. Experiments conducted at the Forest Service laboratory at Washington show that this wood is admirably adapted for the production of paper pulp by the sulphite process. The wood is found to yield very readily to the action of the sulphite liquors used, which is of the usual commercial strength, viz., about 4 per cent. total sulphur dioxide, 1 per cent. combined and 3 per cent. available.

The length of treatment has varied, in the different tests, from eight to ten hours and the steam pressure from 60 to 75 pounds. These pressures correspond to maximum temperatures of 153° to 160° C. The pulp produced in these experiments is from nearly white to light brown in color, according to the variations in the method of cooking, and by selecting the proper conditions of treatment it would be readily possible to produce a grade of fiber which could be used in many kinds of paper without the least bleaching. If, however, it is desired to employ the fiber for white book or writing papers it could be readily bleached to a good white color. It is claimed that, so far as the product is concerned, the manufacture of fiber from white fir would be a commercial success and that the fiber produced would find its greatest usefulness in the production of manilas, where great strength is required, and in tissues which need very long fibers. It seems probable, also, that it would make very good newspaper, for which purpose its naturally light color would particularly adapt it.

ACCORDING to the *Pacific Commercial Advertiser,* as quoted in the *Geographical Journal,* a body known as the Pacific Scientific Institution has been successfully organized, with a view to undertaking a complete scientific exploration of the Pacific ocean and its many islands. While the chief energies of the institution will be devoted to ethnology, the geology and configuration of the region will also be investigated, and studies in zoology and botany will be carried out, as also of winds and ocean currents with a view to throwing light on the distribution of animals, plants, and of the human race. Expeditions are to be despatched in a specially equipped vessel, and it is anticipated that fifteen years may be needed for the work. The moving spirit in the organization of the project is said to be Mr. W. A. Bryan.

THE London *Times* reports that the departmental committee of the Irish Board of Agriculture appointed to inquire into the best means of promoting the reafforestation of Ireland have concluded their labors and that their report will be laid upon the table of the house in the course of a few days. It is expected that the report will recommend that the crown quit rents in Ireland, which yield something like £60,000 a year, shall be applied to the purpose of Irish reafforestation. The report, it is understood, suggests that the work should be carried out under the Wyndham Land Purchase Act of 1902 through the medium of the county councils of Ireland. Already the estates commissioners have acquired two large forests in Ireland for this purpose, one in county Wicklow and another, the Montalt Estate, in county Tipperary. The estates commissioners will manage these forests, preserve the timber, and plant trees where necessary, engaging a staff of foresters for the purpose.

TREES from the United States, Europe and Australia are being systematically introduced into the native forests of New Zealand. In the climate of that country trees from almost anywhere will thrive, and this fact is taken advantage of to plant the most profitable species. Eleven million larches, oaks, spruces, Douglas firs and Eucalypts have been set in plantations, and vast numbers of seedlings are coming on in nurseries. These are rapidly growing species which also make excellent timber. The reason given for introducing foreign trees is that the native trees of New Zealand are too slow in growth. Some of them, as the kauri pine, grow to gigantic size and produce excellent timber, but it takes from 200 years up. Successful forestry demands quicker returns. More rapid changes in animal and vegetable life are taking place in New Zealand than almost anywhere else in the world. The native Polynesian race is rapidly disappearing before the European. The wild animals, native to the islands, amount to little in the contest with animals brought in, many of which now run wild. The streams are full of American and European trout, which grow to enormous size. The very forests are to be replaced, tree by tree, by planting foreign species as the native woods disappear. New Zealand has one million two hundred thousand acres of forest, with two

hundred kinds of trees. It is estimated that the native forests will last, at the present rate of cutting, for seventy years. The replacement will therefore be gradual. But in the end, if the imported trees prove to be more valuable economically than the native ones, they will make up the future forests of the country. Forestry was taken up in New Zealand over thirty years ago, but was abandoned after a few years. The reason given for dropping it was that it cost more than it was worth. After several years of exploitation, it was generally conceded that the abandonment of forestry by the government was a serious mistake, and it was taken up again with renewed energy. Nurseries and plantations are being extended as rapidly as circumstances will allow. The yearly timber cut of New Zealand is about a half billion feet, nearly the same amount as the annual cut of British Columbia.

UNIVERSITY AND EDUCATIONAL NEWS

By the provisions of the will of the late E. W. James, Esq., of Norfolk, Va., the sum of $250,000, in round numbers—the bulk of his estate—will come to the University of Virginia. One half of the income from the bequest, however, is to be paid for a period of fifteen years to the Soldiers' Home at Richmond.

The legislature of Ohio has passed a bill, amending the municipal code of Ohio, so that municipalities may issue bonds for "university purposes." In effect, the law applies only to the University of Cincinnati and provides it with a new source of income, provided the city council approves its desires. Plans for an elaborate extension of the present buildings of the university have been adopted by the board of directors. They include new buildings for the College of Engineering and the College for Teachers, museum, auditorium and combined students' club house and gymnasium. Present conditions indicate that these structures can be built within the next five years, at the most.

By the expiration of life interests and under the will of the late Benjamin D. Stillman, of Brooklyn, Yale University has just come into possession of a scholarship of $10,000. Under the terms of the will the income of the fund is to go to a graduate of the academic department selected annually by the academic faculty for personal merit and good scholarship.

Under the will of the late Mrs. John Rylands, the University of Manchester receives £75,000.

The Goldsmiths' Company has made a grant of £10,000 to found a readership in metallurgy at Cambridge University.

C. H. Beach, professor of dairy husbandry at the University of Vermont, has been elected president of the Connecticut Agricultural College at Storrs.

At the April meeting of the board of regents of the University of Nebraska, Professor C. C. Engberg was promoted from associate professor of applied mathematics to professor of applied mathematics; and Professor W. C. Brenke was promoted from adjunct professor of mathematics to assistant professor of mathematics.

Robert C. H. Heck, of Lehigh University, has been appointed professor of mechanical engineering at Rutgers College. Dr. Ralph O. Smith, of the Pennsylvania State College, has been appointed associate professor of chemistry in the same institution.

Dr. C. H. Neilson has been advanced from associate professor of physiological chemistry to professor of physiological chemistry, in the St. Louis University.

Professor Robert C. Brooks, of Swarthmore College, has been appointed to the new chair of political and social science in the University of Cincinnati.

Mr. H. L. Hollingworth, assistant in psychology in Columbia University, has been appointed instructor in psychology in the University of Nebraska.

Dr. G. H. F. Nuttall, F.R.S., Quick professor of biology and fellow of Christ's College, Cambridge, has been elected to a professorial fellowship at Magdalene College.

Lord Rosebury has been elected chancellor of the University of Glasgow.